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THE SCHOOL OF TROPICAL AGRICULTURE, PERADENIYA.

At the Annual General Meeting of the Ceylon Agricultural Society held in the Council Chamber on August 31st last, the Director of Agriculture announced the projected opening of a School of Tropical Agriculture at Peradeniya. He said:—On November 24th, in seconding a vote of thanks moved by SIR CHRISTOFFEL OBEYESEKERE to SIR HENRY MCCALLUM and other members of the London Committee for their efforts in urging the claims of Ceylon as the site for the Imperial College of Tropical Agriculture, SIR PONNAMBALAM ARUNACHALAM suggested that now that the war had necessitated the College scheme being shelved a small school might be started, adding that now was the time to prepare for the expansion we might expect after the war. I replied that HIS EXCELLENCY THE GOVERNOR had recognised from the first the importance of a School of Agriculture, as distinct from a College. Early this year HIS EXCELLENCY gave instructions for plans to be prepared for the starting of such a school. This has been done, and it is now hoped a School of Tropical Agriculture will be opened at Peradeniya in January next, probably on January 10th. It will be within the recollection of many present that an Agricultural School existed in Colombo, and that on the advice of a Committee appointed by SIR WEST RIDGEWAY it was decided to transfer the school to Peradeniya. The Colombo School was closed down, and now after 15 years we are ready for the next step. Let us hope, if we have been slow, that we are sure. SIR HENRY MCCALLUM

advanced the project of a School of Agriculture at Peradeniya by despatching four students to be trained as teachers at Poona. These students have now returned and are undergoing further training in Ceylon. A course of instruction has been prepared to occupy one year divided into three terms. A special point is being made of practical instruction, the mornings being devoted to demonstrations in the Royal Botanic Gardens and the Experiment Station. In 1900, in a memorandum to the GOVERNOR (SIR WEST RIDGEWAY), DR. WILLIS wrote: "It should be made clear to the students and to the public that attendance at the school in no way implies a promise of Government employment afterwards." It is necessary very emphatically to repeat that warning now. No doubt the time will come when all candidates for posts in the Department of Agriculture, and in the Society too as Instructors, will be required to have taken the school course successfully, but such appointments would be very few indeed annually. The School is intended in the first place for the training of teachers in the vernacular schools with a view eventually to making agriculture a compulsory subject in the code, thus ensuring that the youth of Ceylon shall grow up familiar with the elementary principles of Agricultural Science. These teacher-students will be taught in the vernacular. There will be an English side for the instruction of the sons of landowners and others who are to take up plantation work as a career. A special feature of the school will be the necessity for students themselves working with their own hands at the various planting and horticultural demonstrations and operations. Only in this way can good practical men be turned out. You cannot learn how to do things by looking at other people do them. The inclusive fee for board and tuition is Rs. 30 per mensem; for tuition only Rs. 7·50 per mensem. We are beginning in a very modest way, occupying a bungalow in which there is only limited accommodation, but we shall endeavour to make provision for the boarding of students in other houses if desired.

The prospectus, draft of which was published in our last issue, is now available. In two important respects the new school will have a distinct advantage over the old. It is close to the famous Botanic Gardens and to the Experiment Station, where demonstrations in horticulture and planting operations will be

given daily. We may, I think, say without danger of challenge or of exposing ourselves to the charge of undervaluing the resources of other tropical dependencies, that nowhere else in the Empire could equal educational facilities be found. The second point of importance is that the Staff of the Department of Agriculture, the members of which are specialists in research and in the application of the principles of tropical agriculture, will be responsible for the lectures and demonstrations. The course is fixed for one year, but no one could make himself proficient in the science and practice of tropical agriculture in one year. It may be found necessary, therefore, hereafter to lengthen the course to two years. It has been deemed advisable, however, not to make conditions too severe to begin with.

The projected establishment of this School of Tropical Agriculture has been welcomed by the Press and the Public of Ceylon. It will be up to the public to give it the support necessary to make it an enduring success. We want more of the educated youth of Ceylon on the land, and when they go on the land to take with them some professional equipment. If we can create a supply of well-trained conductors and superintendents we can expect a demand to arise for their services not only in Ceylon but throughout the tropic east. But the doors of the School will be open to the youths of other lands as well, especially within the Empire. We shall look forward to welcoming students from India and Burma, Malaya, Borneo and Papua, and East Africa.

R. N. L.

GRAFTING TAPE

In grafting or budding a suitable tying material is necessary to keep the scion in place and protect it from outside influences. Mr. Wester, horticulturist to the Philippine Department of Agriculture, prefers *grafting tape* as it prevents drying up before circulation has been established between scion and stock, and at the same time keeps out extraneous moisture.

For the wax he recommends equal parts of beeswax and resin. For tape, he considers cheap cotton cloth that tears easily the best. This is torn into strips which are wound round stiff iron wire or pieces of stick and immersed in the melted grafting wax till thoroughly saturated.

COCONUTS.

EFFECT OF LIGHTNING ON COCONUT PALMS.

T. PETCH.

That coconut palms are killed by lightning is well known to all coconut planters. The Editor of the TROPICAL AGRICULTURIST wrote in 1886 (Vol. VI., page 73): "Those connected with coconut estates are aware that, besides the destruction of young trees by grubs or beetles, they must lay to their account a varying but appreciable percentage of loss of trees at all stages of growth from the effects of lightning;" and the well-known Ceylon coconut planter, MR. W. H. WRIGHT, stated in "All about Coconut Planting" (3rd edition, 1914, Appendix, page IV.): "The ills a coconut property is heir to are drought, white ants, beetles, and lightning." The statement of SIR EMERSON TENNENT, referred by SEEMAN (*loc. cit.*), is: "One pre-eminent use of the coconut palm is omitted in all these popular enumerations; it acts as a conductor in protecting their houses from lightning. As many as 500 of these trees were struck in a single pattu near Puttalam during a succession of thunderstorms in 1859."

But though the destruction of coconut palms by lightning is an undoubted fact, it is necessary to exercise considerable caution in accepting that as an explanation of the death of trees in any particular case. As a general rule, the native always assigns the death of a coconut palm to lightning, or, in the rare event of the absence of thunderstorms for any considerable period, to a "falling star" or a "meteorite." Until quite recently deaths from budrot were always so explained, and probably cases of root disease also, while I have been offered the same theory in the case of a tree which was obviously killed by "red beetle" (*Rhynchophorus signaticollis*, Chevr.) When the observer is not the owner of the trees in question, but merely after the storm examines the locality to find out 'what the lightning struck," the possibility of error is still greater, for he is apparently content to accept headless stems as evidence of the lightning stroke, without pausing to consider what has become of the crowns, and in many cases he relies on the evidence of trees, which the pathologist could inform him had been headless for months previously.

The damage inflicted on coconut palms by lightning may take any one, or any combination, of the following three forms:—

(1) The crown may be set on fire.

(2) The tree may be mechanically injured, either by splitting of the stems or by defoliation.

(3) The tree may exude a liquid which dries in red-brown streaks and patches on the stem.

COMBUSTION OF THE CROWN.

This has been recorded by FRANK (KRANKHEITEN DER PFLANZEN, 2nd ed., I., page 241), who states that the dry branches and leaf stalks of palms are sometimes set on fire by lightning.

In 1895 considerable interest was aroused in the Ceylon daily press by the report that a coconut palm had been seen with its crown on fire at Pondicherry. The subsequent correspondence has been recorded in the TROPICAL AGRICULTURIST (Vol. XV.), and from the opinions expressed it would appear that the lightning was generally considered a normal explanation. One correspondent recalled that a similar occurrence had been observed in 1893 or 1894 near Christ Church, Colombo, during a severe storm (TROPICAL AGRICULTURIST, Vol. XV., page 351); while MR. W. H. WRIGHT stated that some time ago he had witnessed a coconut tree taking fire from a flash of lightning just before the rain came down, but he had never seen any tree on fire during the rain, a fact which he thought might be explained by supposing that the tree could not take fire when wet. On the other hand, another well-known coconut planter, MR. JARDINE, wrote that he had never seen a coconut tree set on fire by lightning or a meteorite, though he had seen hundreds struck by lightning (TROPICAL AGRICULTURIST, Vol. XV., page 345).

In 1907 it was reported in the local press that a coconut palm in Colombo had been set on fire by lightning during a storm.

This effect would appear to occur in the case of coconut palms in town gardens, where many old trees, hemmed in by buildings, are barely able to exist, and so may bear more dead and dry fronds than their more fortunate relatives on cultivated estates. But it is certainly not the most usual effect of lightning. That it should occur before the rain and not during the storm is only to be expected, as the coconut stem is rapidly wetted by the stream of rain water which descends from the crown, and under such conditions it forms an efficient conductor.

MECHANICAL INJURY.

H. H. THIELE, writing in the FIJI PLANTERS' JOURNAL (see TROPICAL AGRICULTURIST, December 1913, page 462), states: "Lightning will, as a rule, shatter one or two trees badly, and those standing close by will be damaged by the heat to such an extent that they get diseased, their tops rot, and they die, their stems being marked with a number of brown spots." How far this is based on actual observation is not apparent.

In the TROPICAL AGRICULTURIST, Vol. VI., page 73, the Editor writes:—"During the last monsoon storms twelve fine palms, a little to the south of Kollupitiya station, were struck. Five of these were practically decapitated and others were badly burnt, but some were only affected so that slight brown colour showed on a few of the branches."

Shattering of the stem or immediate decapitation of the coconut palm would appear to be rare. I have never seen any case of decapitation as a direct and *immediate* consequence of lightning. Of course, when a palm dies after having been struck by lightning, its crown ultimately decays, and only the headless stem remains after a few months. In the only case of mechanical injury which I have observed, the stem bore two short vertical wounds, one at 12 feet and the other at 18 feet from the ground, from each of which the fibres were protruding in loose bundles.

EXUDATION OF LIQUID.

This is by far the commonest effect of lightning on coconut palms. As a rule, no sign of injury to the stem, or scorching of the crown is observable, but the stem exudes at numerous points a liquid which dries in red-brown streaks and patches on its surface. The earliest stage of this which I have seen was two or three days after the tree had been struck. The plantation was fourteen years old and the palms were 22 feet apart ; all were about the same height, but only one was affected. It did not appear to differ in any respect from the surrounding trees, and there was no apparent reason why it should have been struck rather than any other. Its stem was about 10 feet high, and the central spike about 10 feet more ; in consequence of its small stature, the tips of the decumbent outer leaves nearly touched the ground.

The stem was not split or marked by the lightning in any way. Owing to the collapse of the inner tissues of the bud, the central spike had fallen over, but it was still green and not charred. The outer leaves, i.e., those which bent over towards the ground, were charred along the midrib ; and round the tree, at distances of 8 or 10 feet from the trunk, the grass and weeds were burnt in small patches, each patch being situated below the point of a leaf. But the most striking phenomenon was the exudation of sap from the stem. Liquid was oozing out from the innumerable cracks which are always to be found in the "rind" of the coconut stem, forming white frothy masses and then running down in long red streaks. The appearance gave one the impression that the whole of the internal tissues were undergoing rapid fermentation. On cutting into the stem the internal tissues were found to be slightly pale brown, uniformly coloured and full of sap. It is to be regretted that, as the tree was situated in a district at least three days' journey from a laboratory no further investigation could be made.

Another case was examined about a month after the occurrence. A breadfruit tree (*Artocarpus incisa*) was said to have been actually struck, and this was dead and leafless, though its trunk was not split. Close to it was a coconut palm about 12 feet shorter. This was not quite dead ; it showed long red streaks of sap, particularly in the lower half of the stem, and had two short vertical wounds, one at 12 feet and the other at 18 feet from the ground, from which the vascular bundles were protruding in loose masses. Westward from these two, the palms only 15 feet away showed no sign of injury, but to the east 20 trees, which were taller than the breadfruit tree, were affected. Their trunks bore red bleeding spots and their crowns were scorched, the outer leaves being generally withered and drooping, though the youngest leaves were still erect and green. None of these showed any injury to the stem, except the exudation of sap. Two palms had been felled, as being beyond recovery, and four others appeared to be dying. The tree with the worst crown was about 20 yards from the breadfruit tree, and the affected area formed, roughly, an ellipse, with the breadfruit tree at one focus.

In general, the effect of lightning on coconut palms may be summarized as follows :—A group of trees, not differing in any obvious respect from the surrounding trees, is affected ; sap exudes from the trunks of all these trees ; their crowns are slightly scorched ; one tree is more severely affected than the others, and this is regarded as the tree actually struck. In some cases longitudinal wounds are made in the stem ; and if the crown is surrounded by dead leaves these may be set on fire. But apparently these last two effects are rare. The occurrence of injured trees in groups is especially remarkable.

As regards the ultimate fate of coconut palms struck by lightning, there would appear to be a considerable difference of opinion. To quote again from the TROPICAL AGRICULTURIST (Vol. VI., page 73) : "On one occasion, when a crash gave rise to the impression 'the sky had fallen,' we felt certain that something had been struck, and on going to the seashore we found seven coconut trees affected, some killed outright, and others with only the edges of their branches (i.e., leaves) singed. But ultimately every tree, however faintly affected, died. During the late monsoon storms twelve fine palms, a little to the south of the Kollupitiya station, were struck. Five of these were practically decapitated, and others were badly burnt. But some were only affected so that a slight brown colour showed on a few of the branches. Amongst the latter is a tree with a magnificent head of fruit, and this morning we expressed our fears, based on our experience, to a good native authority, that this valuable tree was as much doomed as those whose vitality had been at once destroyed. He fully confirmed our opinion : the tree must die." It would have been of greater value if the fate of this tree had been recorded. With regard to the first of these occurrences, the statement that several trees were immediately "killed outright" makes the record somewhat doubtful.

The general opinion, however, inclines to the belief that coconut palms which have been struck by lightning may recover if properly treated. The treatment adopted by the native is apparently based on the observation that a liquid exudes from the stem ; he merely cuts a hole in the stem "to let out the excess of sap." W. H. WRIGHT, in "All about Coconut Planting" (3rd edition, Appendix, page iv.), states : "When a tree has been partially struck by lightning, steps should at once be taken to bleed it and the surrounding trees by boring holes at their bases with an auger, by which means a large percentage can be saved. Any tree, however, which has been irretrievably struck by lightning should at once be cut down and burnt."

The distinction between "partially struck" and "irretrievably struck" would appear to afford a convenient explanation in case the treatment failed. It does, however, appear to be correct that when a group of coconut palms is struck, some are more lightly affected than others. The former are not regarded as actually struck, but as "affected by the heat." Their case may be analogous to that of the tea bushes which die round a rock which has been struck by lightning on a tea estate. It would appear to be open to question whether the trees which recover after the treatment described would not have recovered without treatment of any kind.

No explanation of this "fermentation effect" can at present be offered, and the facts have been placed on record here in the hope that the subject will be taken up by others more favourably situated for detailed investigation. It may, however, be pointed out that the same effect may be produced on a small scale by making a fire near the base of a coconut palm, but not near enough to char the stem. The red-brown patches subsequently appear on the parts which have been heated. A number of red-brown spots and streaks at the base of the tree, usually on one side only, indicates that it has been injured by fire. This appearance is very common, more so in native gardens or on trees near a native hut, than on estates. If a fire is made quite close to the base of a coconut palm, the outer stem issues are, of course,

burnt and charred; but when it is too far away to admit of this, the stem is heated, especially if the wind blows the flames in that direction, and it afterwards exudes a red-brown liquid from dozens of the pre-existing cracks. It is notable that in some cases, not, however, universally, when the lower part of the stem is severely charred, the parts immediately above this do not bleed; on the other hand, if the stem shows no blackening whatever, it bleeds vigorously. Probably in the first case the supply of sap to the upper parts of the cortex is cut off altogether.

I have seen an area of several acres affected in this way, where the grass had evidently been burnt off a long time before. All the trees were marked with red-brown spots to a height of about 3 feet on one side only. Apparently a quickly advancing fire had not been strong enough to char the stems, or to heat them sufficiently on the leeward side to cause them to bleed.

A good example of this was furnished by a group of old coconut palms over sixty years old on the Experiment Station, Gangoruwa. The plot being more or less waste ground, it was used for storing the thinnings of the cacao plots in 1907, and these were set on fire in February, 1908, without any regard for the coconut palms. When examined in April, 1908, the lower parts of the stems, sometimes to a height of 25 feet, were covered with small red-brown patches. The liquid had issued from the cracks and had dried round them; it had not run down the stem, as in the case of a severe lightning stroke. The cortex under each patch was slightly decayed and brown, but it afterwards dried up. Four trees were marked above the highest red-brown patch. On three of these the bleeding had not extended further up the stem by March, 1909, but on the fourth there were fresh spots higher up the stem at the end of July, 1908. As a rule, on trees which have been injured by fire the bleeding occurs immediately afterwards, and the spots do not subsequently increase in number or size. Only the cortex is affected, and the amount of sap which exudes is small. But when trees are severely struck by lightning, the exuding sap is derived from the whole of the inner tissues, and issues in such quantity that it runs down the stem in long streaks.—ANNALS OF THE ROYAL BOTANIC GARDENS, PERADENIYA.

COCONUTS IN BRITISH GUIANA.

PROFESSOR HARRISON, Director of Agriculture, British Guiana, in an exhaustive article contributed to the BULLETIN OF THE IMPERIAL INSTITUTE on the Field and Forest Resources of British Guiana,* states that coconuts thrive well on the coastal lands of the colony, especially where the land is more or less of a sandy nature, and expansion of this cultivation is steadily taking place.

The coconut palms growing in the colony are scattered, being owned chiefly by small growers, but there are a few fair-sized coconut estates, whilst extension over large areas is taking place on some sugar plantations. Reefs of light sandy loam exist on the Corentyne Coast, along the east coast of Demerara, and in Essequibo, where coconuts flourish; and even on the

* Extracts from this article on Coffee, Cocoa, and Balata, will be found on other pages of this Journal.—Ed. T.A.

heavier coastal lands they grow satisfactorily and bear heavily. They do not grow so well or yield satisfactorily on the pegassy clay lands and on river lands away from the coastal region.

The area under the crop is now over 15,000, but much of this consists of young plantations. Little copra is exported (1,690 cwt. in 1914), the nuts going chiefly to the United States.

GERMAN SUBSTITUTES FOR RAW MATERIALS.

Of substitutes for olive oil there were already several derived from nuts of various kinds. Latterly, since the supply from Italy has ceased, German ingenuity has set to work to find substitutes in addition to those already existing. One of the leading chemists told me as a fact that the Germans are now extracting a substitute for olive oil from cherry stones, although he did not know, and I cannot say, on what scale the experiment is being conducted. At any rate, "save your cherry stones" had already been started during the cherry season on its career as a popular domestic war cry. I am told that since almost any kind of fruit stone contains glycerine, as does olive oil, it might be possible to produce a substitute from it. But whether any process would be quantitatively worth while is another question. In any case, the Germans have not neglected the possibility.

Germany has likewise developed since war began the original Norwegian process for extracting nitrogen from the air. The claim of her newspapers that this is a German invention is, of course, an impudent lie. It is only so far of German origin in that SAMUEL EIDE, the Norwegian chemist, who worked on the process in conjunction with PROFESSOR BIRKELAND, of the University of Christiania, did study at one time at the Technical High School of Charlottenburg. Previously Germany obtained most of her nitrogenous material from Chili. Her air-extracting process provides her now with the three important substitutes of ammonium nitrate, used in the manufacture of explosives, sodium nitrate, used in colouring, and concentrated nitric acid.

NO SUBSTITUTE FOR RUBBER.

In only two cases must some doubt be thrown on a German claim to the invention of substitutes. She is scouring every available neutral country for rubber, which hitherto her synthetic experts have not been able to replace, and, despite all her claims to the contrary, it is more than doubtful whether she has really perfected a cheap substitute for cotton to be used in the manufacture of propulsive explosives. Her claim in this respect is to have invented a process for purifying wood fibre and making it available for use in guncotton. But, as has already been stated in a previous article, this assertion is believed in the neighbouring neutral countries to be little more than a "bluff" intended to discourage the Allied Governments from declaring cotton contraband. Her extreme anxiety to get cotton was very obvious to any visitor to Stockholm of late, as I recently stated.—THE TIMES.

RUBBER.

DESTRUCTION OF RUBBER BY MICROBES.

It is said in the REVUE SCIENTIFIQUE that microbes do not attack commercial rubber which is kept in dry air, but when a small amount of moisture is present certain bacteria and moulds derive nourishment from the albuminoids, resins and sugars which the rubber contains. Some microbes form on the rubber, making spots of various colours—red, yellow, black or brown—but the rubber is not materially altered thereby. On the other hand, two species of *actinomyces*, very common in garden earth and in canals, *Actinomyces elastica* and *A. fustus*, assimilate the hydrocarbons of the rubber, and are in consequence capable of modifying its properties in such a way as to deprive it of all commercial value.—INDIA RUBBER WORLD.

DISEASES OF HEVEA.

"Canker" of *Hevea brasiliensis* was rather common during the latter half of 1912, but appears to have been less prevalent during 1913. It has been found that the leaf fall which often follows the fruit disease, and is characterised by the appearance of a dark-brown ring on the leaf stalk, is caused by the canker fungus (*Phytophthora faberi*). Decay of the renewing bark is still common in wet weather; the use of carbolineum plantarium, which has been found to stop this decay in Java, has been recommended, and this substance is now available in the Island. The Assistant Botanist and Mycologist is investigating the nodule formation on Hevea. Other diseases of Hevea have called for much attention recently.

In dealing with the diseases of rubber trees in bearing, one is handicapped by the fact that the best fungicide available, Bordeaux mixture, is a copper compound, since traces of copper in the rubber are known to turn it tacky. Lime sulphur mixture, which is frequently recommended, has been found useless against a disease caused by *Phytophthora*, as "canker" is. An experiment carried out during the wet months of 1912 would seem to show that the amount of copper salts found in the rubber after spraying with Bordeaux mixture is insufficient to cause tackiness. The trees were sprayed during dry weather. The first heavy rain occurred five days later, and the rubber collected the following day was made into biscuits, which were subsequently analysed. The biscuits, all in biscuit form, from this row of trees for the next seven months was kept under observation, but no tackiness was noted. At the request of the Kalutara Planters' Association, Hevea "canker" has been placed under the Pest Ordinance.—ANNUAL REPORT OF THE BOTANIST AND MYCOLOGIST.

SOME SCIENTIFIC ASPECTS OF LATEX COAGULATION.

One of the most interesting questions raised in connection with the process of rubber preparation is that of the mechanism of the coagulation of the latex. It is part of one of the most recent subjects of modern science—colloid chemistry. In the first place it may be mentioned that the term coagulation is one which has been rather indiscriminately used, for the reason

that investigation of the coagulation of suspensions and emulsions, etc., has not yet been sufficiently detailed to allow of the definition of different types or degrees of coagulation. Whitby is of the opinion that there are three stages in the degree of coherence of rubber separated from latex, viz., creaming, flocculence or agglutination, and coagulation. The present writer is of the opinion that there is a fourth variety which he would term flocculence, the term agglutination being reserved for the type we observe in the clotting of latex which is left to itself without addition of acids.

Thus, *creaming*, is the conditions observed in the early stages of slow coagulation; the latex thickens and becomes of a creamy consistency.

Flocculence could be the term applied to the formation of small particles of rubber without coalescence of the same to form lumps. This state is observable in latex to which much formalin has been added.

Agglutination is applicable to local or lumpy coagulation observed when the latex coagulates spontaneously or when certain mineral salts are added.

Coagulation proper is the final stage observed on careful addition of acids to latex, the rubber forming in one clot and leaving a clear liquid.

Now rubber latex is one member of the class of colloids but it is by no means a simple member. In latex we have a suspension of rubber particles or at any rate a suspension of the particles which subsequently form rubber, but we also have at the same time a number of bodies in solution some of which belong to the class known as proteins. These proteins are in colloidal solution and are capable of being precipitated by certain reagents, notably acids. It seems probable that this protein acts as a protective colloid to the pure rubber substance caoutchouc. The theory of this protective action is that a suspension such as that of the caoutchouc substance when mixed with a colloidal solution of such a body as protein acquires many of the characteristics of the substance in colloidal solution. It has been suggested that this protective action is due to the absorption of a layer of the dissolved protective agent over the surface of each of the suspended particles. That this is so in the case of the rubber particles seems probable in view of the fact that it does not behave as a pure suspension but that its coagulation reactions resemble in many respects those of certain proteins. Not all the nitrogenous constituents of latex, however, are precipitated with the rubber during the ordinary process of coagulation.

Again, in considering the effects of anti-coagulants we may have many factors at work. The anti-coagulant may be an alkaline substance acting so as to neutralise acid formed in the latex by decomposition or fermentation, or it may act as a retarding agent on the coagulating enzyme said to exist in the latex. Again it has been observed that formalin when added in certain proportions to the latex acts apparently as a retarding agent in that the latex still retains its milky appearance and the rubber does not form a clot but actually the latex has lost its original nature and consists of a number of particles of rubber in suspension in a clear liquid. In this connection it may be observed that formalin is a coagulant of certain protein bodies.

Again the question of heat enters very largely into operations such as the coagulation of latex by the Brazilian and similar processes. The writer found that in the Wickham Process if the temperature of the jet of smoke impinging on the band of latex be less than 60° C, coagulation is not obtained. Whitby states that heat alone will coagulate fresh latex, a temperature of 65-70° C being required. The writer also found that on heating the latex to 60° C a certain quantity of acid coagulated the latex almost immediately, whereas in the normal course of events it would have required some hours. The object of this article has been to show the complicated nature of only one section of the process of rubber preparation, and only the surface of this question has been touched. The question is found to be still more complicated when we get below that surface.

L. E. C.

COCOA.

COCOA IN BRITISH GUIANA.

PROFESSOR HARRISON.

Cocoa planting is an industry of some promise in parts of the colony, but unfortunately it requires for its successful installation command of more capital than small farmers usually possess. Cocoa requires for its satisfactory growth land well drained to the depth of from 3 to 5 feet, and on land of this sort it does very well indeed. There are great areas of land a few miles up the lower reaches of the rivers, where good drainage can be easily ensured, and upon them cocoa flourishes. It is to be regretted that persons with command of sufficient capital and with knowledge of the cultivation of cocoa have not taken up its growth in these parts of the colony to a greater extent than has been done.

Some of the cocoa estates are of fair age, but there are also considerable areas under young trees that have not yet come into bearing. The Government has an experimental area of cocoa at Onderneeming, Essequibo, where from selected trees of high yield and good quality seeds are obtained for propagating purposes, and increasing numbers of promising cocoa seedlings are being supplied at low cost. Systematic experiments with cocoa were commenced at Onderneeming in 1900. They have proved of value to the cocoa cultivators in the colony by indicating that largely increased yields are obtainable by the reduction of the shade trees to the minimum necessary for protection of the cocoa trees against wind, that large increases in yield result from heavily mulching the trees, and that the most profitable applications of artificial manures are of mixtures of sulphate of potash and superphosphate of lime, to which additions of nitrogenous manures are seldom remunerative, whilst nitrogenous manures *per se* tend to reduce the bearing powers of the trees.

The acreage under cocoa cultivation during recent years is as shown below :—

		Acres.			Acres.
1907-8	...	1,832	1911-12	...	2,127
1908-9	...	2,181	1912-13	...	1,983
1909-10	...	2,223	1913-14	...	1,863
1910-11	...	2,016	1914-15	...	2,316

The decreases in the area returned as cultivated in cocoa in the years 1912 and 1913 were attributed to the drought of 1911 and 1912, and to the abandonment of cocoa in some cases for rubber cultivation. Practically only the Forastero variety is grown in British Guiana, other sorts being cultivated only to a very small extent.

At present, therefore, only about 2,000 acres are planted in cocoa; their yield is mostly used for the local demands of the colony, and thus the export is small—not more, as a rule, than from 750 to 900 cwt. per annum. That exported brings a good price, owing perhaps to the great care which is exercised in fermenting and curing the beans.

On some plantations kola nuts are grown among the cocoa, producing a small yearly output of about 40 cwt. Among subsidiary products which do well wherever cocoa and kola flourish, nutmegs occupy a prominent place.—

Bulletin of the Imperial Institute.

COFFEE.

PREPARATION OF COFFEE.

Two methods are employed in converting coffee fruits or "cherries" into saleable coffee, viz. (1) the dry method and (2) the wet method. The former is the more primitive and is still practised to a certain extent in some countries, but the second method is preferable and should be employed if possible.

THE DRY METHOD.

This method has the advantage of being serviceable when cherries in different stages of ripeness have to be handled at the same time, owing to the crop ripening irregularly, and labour being scarce or dear, so that successive gatherings are impracticable, or to the lack of a good supply of water. Its success, however, is dependent on the continuance of fine weather over a fairly considerable period.

The gathered cherries are spread in a thin layer on open drying grounds or barbecues. These should if possible be made of brick or cement, although clay will serve. The cherries are turned over, made into heaps, and spread out again, to ensure even exposure to the sun. After the first two or three days, when the coffee is beginning to dry, it should be placed under cover at night if dews are prevalent and exposed again on the drying floor the next day. It is also necessary to protect the coffee from rain. If only small quantities are being dried the cherries may be exposed on small wooden trays which can be easily handled and carried bodily under cover when necessary. When the cherries become quite dry, which even under good conditions usually takes about three weeks, they may be stored.

The next stage is to remove the dried husks from the cherries. This may be done by threshing with a flail or by pounding in a large mortar, the particles of shell and dust being removed by winnowing. The threshing or pounding, however, usually leads to the breaking of a considerable proportion of the beans, and it is preferable to use a hulling machine, which can be obtained of a size requiring either hand or mechanical power.

THE WET METHOD.

This is the more modern method of preparation, and is the one practised on all up-to-date plantations. It requires a fairly considerable amount of equipment in the form of buildings and machinery, and care must be taken in selecting the site for the factory. Much water is required, and the factory must therefore be situated where there is an ample and constant supply. It is an advantage if the buildings can be erected at the foot of a slope, as it is then possible to so arrange the required machinery on different floors that the fresh cherries can enter at the top of the building and pass downwards through the various stages of preparation with a minimum amount of handling. As far as possible throughout the preparation mechanical appliances should be used in order to economise the expense of labour.

To obtain the best results by the wet process the berries should be quite ripe and should be dealt with the same day as picked. The cherries, as they are brought in from the plantation, are placed in tanks of water, built of concrete and of a size proportionate to the quantity of fruit brought in daily. The ripe cherries sink, and are drawn off through a pipe in the base, but on a small scale the water may be emptied out and the sunken cherries removed.

The next stage is the removal of the pulp which surrounds the beans. This is effected by special pulping machines. On a large scale the cherries are delivered directly from the tanks in a stream of water to the hopper of the pulper. The latter may be obtained in various sizes, from small hand machines to the large power-driven ones used on the large estates. Those in common use are of two types, the cylinder machine and the disc machine. In the former case the disintegrating apparatus usually consists of an iron cylinder covered with punched copper, like a large nutmeg-grater, which rotates close to a pulping bar or breast. The cherries are fed by a stream of water into the hopper, which is usually fitted with a device for removing stones, and then pass through the pulping mechanism, the pulp and the beans being delivered separately. As a general rule some imperfectly pulped or unpulped cherries pass over with the beans and these can be separated by a rotary screen or oscillating sieve, the unpulped material being repulped. Double machines are in use in which the unpulped cherries delivered from one cylinder are automatically separated from the beans and carried to the hopper of a second cylinder, which is specially adjusted to pulp them. Some machines are fitted with a crushing apparatus which partially pulps the cherries before the latter pass through the pulping cylinders. Great care is necessary to see that the machine is properly adjusted, and the maker's instructions on this point should be carefully carried out. If this is not done the cherries will be imperfectly pulped or the beans may be damaged.

The disc pulpers, which are said to require less water than the cylinder machines, possess one or more vertical iron discs, covered with copper, bearing solid projections. The discs rotate against adjustable pulping bars with steel faces, the beans and pulp being delivered separately as in the case of the cylinder machines.

The pulped cherries, after leaving the machine, are always mixed with a certain amount of pulp, and to remove this they are sometimes passed on from the pulper to a receptacle containing water, in which they are stirred about with poles, paddles, a revolving wheel, or other suitable device; or they may be placed in a tank with a small amount of water so that they can be trampled upon by bare-footed men. More water is then added, the mass is stirred up, and the light pulp got rid of by withdrawing the water from above. The beans, still enclosed in the parchment, remain at the bottom of the vat, and are left comparatively free from pulp when the water is removed. If it is found that the amount of pulp present with the beans on leaving the pulper is small, this washing may be dispensed with.

The parchment in any case, however, is still very slimy owing to portions of the pulp, etc., remaining adherent to it. This material is removed by fermenting the coffee, for which process the beans are piled up in a heap under cover, or more usually placed in special receptacles. The fermentation may be carried out in the washing tank after removal of the water. When fermentation is complete the parchment coverings no longer feel slippery but

are slightly rough. The exact time taken for this process may vary from one to three days, and a handful of beans should be taken out occasionally in order to ascertain when the fermentation is completed. If fermented too long the quality of the coffee will be affected.

The beans are then washed again, the parchment being now left clean. The washing may be carried out in the manner already described, or in one of the special mechanical washing machines now on the market.

The washed parchment coffee is next spread out in a thin layer (3 to 4 in. deep) on a smooth drying ground of cement or brick, and raked over several times daily at first to ensure uniform drying, or it may be placed on trays made of ¼ in. woven wire, which are supported on a framework 3 or 4 ft. high. After the first day or two the coffee should be protected from night dews and rain. If the weather cannot be depended on during the drying period artificial drying must be resorted to, for which purpose several good machines are available, while good results have been obtained in some countries by utilising flue-heated tobacco-curing barns. A good method is to partially dry the coffee in the sun and finish in a machine. The effect of sun and artificial drying on the size of the beans is dealt with subsequently.

The actual duration of the drying period varies. For sun-drying a bout ten full days' sunshine is necessary, but some kinds of hot-air driers will completely dry the coffee in twenty-four hours. It is essential that the coffee should be completely dried, as, if shipped in a moist condition, it develops a musty smell, which is difficult to get rid of. When thoroughly dry the parchment can be crumbled to dust by the fingers, and the bean is hard and cannot be dented by the finger-nail or teeth.

The next process is to remove the parchment. This operation may be carried out on the estate, at the port of shipment, or in the country to which the coffee is exported.

To effect the removal of the parchment the dry coffee is fed into a machine known as a "peeler and polisher," fitted with screw or cone rotating inside a cylinder. The parchment as well as the silver skin surrounding the bean is broken up by this means, and at the same time the beans are polished. The broken husk and dust are removed by means of a sieve and by winnowing, or by means of an exhaust fan attached to the machine.

Grading follows next, i.e., the sorting of the beans into various sizes. This can be done in a simple manner by sieves with meshes of appropriate dimensions, or by special sizing machines. There are several forms of the latter, and as a rule at least two are necessary in order to separate the beans into uniform grades. In London the usual grades are peaberry (the spherical beans), bold (the largest flat beans), medium, and small.

The question as to whether the planter cleans and grades his coffee or exports it in the parchment, is one which he must decide for himself on the conditions obtaining locally. It may be mentioned, however, that Uganda coffee cleaned and graded in London has, in certain cases at least, proved to contain a larger proportion of the higher grades than coffee cleaned in Uganda, and moreover, the London cleaner can grade according to the demands of the market. BROWN and HUNTER (PLANTING IN UGANDA, London

1913, p. 170) point out that two consignments consisting of identical sun-dried coffee, shipped at the same time, one cleaned in London and the other in Uganda, yielded the following percentages of the different grades :—

		Peaberry.	Bold.	Medium.	Small.
Uganda cleaned	...	9·41	6·22	46·87	37·50
London cleaned	...	6·00	56·00	20·00	18·00

The difference in price between bold and medium was about 3*s*. per cwt., so that the advantage in this consignment was enormously in favour of London grading.

The same authors also quote comparative figures relating to sun-dried and artificially-dried coffee. Two consignments were shipped together and were precisely similar, except that one-half was sun-dried and the other machine-dried. The percentages of the grades obtained when cleaned in London were as follows :—

		Peaberry.	Bold.	Medium.	Small.
Sun-dried	...	3·13	26·56	35·94	34·37
Artificially dried	...	5·35	58·03	21·45	15·17

These figures show that artificial drying results in less shrinkage of the bean than sun-drying, and consequently a very large increase in the higher grades.

Before the graded coffee is put on the market, it is usually hand-picked in order to remove discoloured and faulty beans. On a large scale the beans are delivered on to a travelling band, the defective beans being picked out by the operator, the good coffee being delivered into a bag.

The coffee is shipped in bags, double bags being used in some cases, and each consignment should be sent off as soon as it is ready, as the coffee deteriorates in appearance, and consequently realises lower prices if stored for some time.—BULL. OF THE IMP. INST.

COFFEE IN BRITISH GUIANA.

PROFESSOR HARRISON.

In the earlier part of the last century British Guiana, and especially the county of Berbice, was celebrated for the high quality of the coffee it produced. Unfortunately, about the time of the cessation of slavery, circumstances beyond the control of the planters necessitated the gradual abandonment of the cultivation.

At the present time about 3,800 acres are occupied in coffee cultivation, a large proportion of the product being consumed locally. Two kinds of coffee are cultivated in the colony, the Arabian or so-called Creole kind, and the Liberian variety. Both sorts grow with exceptional vigour, and the former is singularly free from disease.

Large areas of low-lying land in British Guiana are ideally suited to the growth of Arabian coffee. The meteorological conditions of these parts of the colony are very similar to those of the higher parts of many of the West Indian Islands, and when this is borne in mind the excellent way in which coffee grows on them ceases to be surprising.

It is greatly to be regretted that local conditions, especially scarcity of available labour, tend to restrict the extension of the area under cultivation, and that the usually low price of coffee does not offer much inducement for small capitalists to take up its cultivation.

The Liberian variety grows very well indeed in many parts of the colony, and wherever it flourishes it is very prolific; in fact, at times the difficulty is to restrain its bearing propensities sufficiently to prevent the tree permanently injuring itself. It is, however, on the wind-swept parts of the coastlands more adversely affected by unfavourable meteorological conditions than is the Arabian kind. But this is not the case at some distance back from the coast-line and on the lands along the lower reaches of the rivers.

The annual exports of coffee during recent years may be seen from the following statement:—

		cwt.			cwt.
1907	...	2	1911	...	1,225
1908	...	190	1912*	...	727
1909	...	1,122	1913*	...	798
1910	...	978	1914	...	2,132

—BULL. OF THE IMP. INST.

OIL CONTENT OF SEEDS.

The JOURNAL OF AGRICULTURAL RESEARCH publishes the results of the work of GARNER, ALLARD and FOUBERT on the relation of the oil content to nutritive and other conditions, and though their researches deal with cotton seed, ground nut and soy bean, the deductions are most interesting. To what extent they would equally apply to the coconut is not indicated, but it may be assumed that the general tendency of the controlling conditions would be the same.

It was found that for a high yield of oil the plant should have facilities for storing carbohydrate food with a view to its subsequent transformation into oil. No apparent relation was found between the size of seed and its oil content. The effects of different types of soil on the oil content were neither specific nor constant, but depended largely on seasonal conditions, climate more than soil being the responsible factor, seeing that climate materially influences such conditions as temperature and moisture.

Within ordinary limits the relative fertility of the soil appears to have only a small influence on oil seeds; though the use of a complete manure on an unproductive soil gave larger seed with a higher percentage of oil.

* Crops affected by the prolonged drought of 1911 and 1912.

SUGAR.

THE PAST HISTORY AND PRESENT POSITION OF THE SUGAR INDUSTRY.

W. G. FREEMAN.

If we go back a hundred years, we find that the sugar cane was the dominant plant and the sole source of sugar for the civilised world. Still earlier, in 1747, a German chemist, MARGGRAF, had shared the possibility of getting sugar from the beet. In 1797 a French refugee, ARCHARD, continued the work, and about the beginning of the last century the first experimental factory for beet was started in Silesia with a capacity of something like 525 tons of roots a year, which would probably produce about 30 tons of sugar. The baby-hood of the best industry was greatly affected by continental wars. NAPOLEON, as you are probably aware, attempted to stifle England's commerce by a continental blockade, his main object being to keep out from Europe the products of the British Colonies (which at that time were chiefly cotton, sugar and indigo.) The result of this was a great impetus to the beet industry and NAPOLEON himself in 1811 ordered that 80,000 acres in France be planted in beet. The industry flourished for a time, and in 1812 there were forty beet sugar factories producing 10,000 tons of sugar per annum. After the Napoleonic Wars, the industry dropped again and in 1829 the beet sugar production was only 4,000 tons. In 1835 Germany also took up the industry seriously. By 1860 the world's production of sugar was 1,500,000 tons, cane sugar 1,250,000 and beet 250,000. Both France and Germany seriously fostered the beet industry, and it is very interesting to follow the results of the more scientific taxation of Germany as compared with the cruder method of France. Germany encouraged the industry along lines which gave great incentive to research by botanist, chemist and engineer by levying duties not on the amount of sugar which the factory produced, but on the amount of roots which were taken in. In France, on the other hand, the tax was put on the amount of sugar produced. There was therefore a greater incentive to improve the sugar contents of the beet, thus escaping taxation. The results were very marked. In 1871 France produced 284,000 tons of sugar and Germany produced 186,000 tons, the beet in both containing about 6 per cent. of sugar. In 1884 the German production had gone up to over 1,000,000 tons, whereas the French production had gone slightly back from 284,000 to 265,000. Still more striking was the improvement effected in the beet. In 1871 the roots in both countries contained about 6 per cent. of sugar; in 1884 those in France had not improved, whilst in Germany the sugar contents had been raised to 11 per cent. France then adopted the German system and taxed the roots which went into the factory. Thirteen years later the production in France had gone up to 1,500,000 tons and in Germany to 1,850,000, and the sugar contents of the French was about 11 per cent. and in Germany from 11 to 12·66 per cent. During a great part of this period there had been in both countries a drawback on sugar exported. In

1892 Germany altered her system from duty on roots to duty on sugar with a direct bounty or bonus of £5 per ton on exports. The other continental countries worked on more or less similar lines, and as a general result the beet industry increased from 250,000 tons in 1860 to 6,000,000 tons in 1903. During the same period the sugar cane production had gone from 1,500,000 to 5,800,000. In 1903 the Brussels Convention of 1902 became operative. It abolished the bounty on beet sugar. The result was a great stimulus to cane sugar. By 1914 beet had only gone up from 6,000,000 to 6,800,000, whereas cane sugar had progressed from 5,800,000 to 9,000,000.

At the present time Germany and Austria produce more sugar than the whole of the British Empire. The total amount of sugar used annually in the United Kingdom is 1,800,000 tons; beet 1,500,000, and cane sugar only 300,000, of which only a small amount comes from the British Empire, and the rest from foreign countries. In the British Empire the sugar position is thus entirely different from that of cacao. The British Empire is very largely dependent on foreign sources of supply for its sugar. The Brussels Convention put an end to the artificial stimulus given to the beet sugar industry, and since 1903 beet and cane sugar have competed on equal terms—as far as they can be equal. Beet has the great natural advantage that it is produced near the great centres of consumption and thus has a natural protection in the form of cheaper freights. Beet sugar has one great disadvantage; its impurities are very objectionable compared with those in the cane sugar.

At the outset of the war, the Home Government was faced with a shortage in sugar supplies; it acted promptly and purchased 900,000 tons of sugar at £20 per ton (at a total cost of £18,000,000) the biggest sugar deal ever made in the world. It has also prohibited the importation of sugar from other countries for the reason that importation from a natural country such as Holland might be merely a means of passing German sugar through that country to England. West Indian sugars, as you are aware, can be imported by license. From the most recent accounts, it does not seem that the war up to the present, except in northern France, has very seriously affected the beet sugar output, and therefore the immediate difficulty in Europe is not so much the production of sugar as getting rid of it. Accordingly much is being stored, causing demand for proper storage facilities as there is a lack of suitable warehouse accommodation for very large quantities of sugar. In one of his very interesting letters in the LOUISIANA PLANTER MR. P. GEERLIGS describes how Belgian refugees have been turned out of warehouses in Holland in order to make room for sugar.

If the war suddenly came to an end the situation would be that a very large quantity of German and Austrian sugar would be dumped on the home market unless there was some sudden change in the fiscal policy of the United Kingdom. So that unless the war goes on for a comparatively long period over this year, there is no guarantee that the present prices of sugar will be maintained. Supplies in England are said to be sufficient to last until May, but an early peace will liberate large quantities of sugar with a consequent drop in prices. Speaking in the House of Commons early in February, MR. ASQUITH, the Prime Minister, announced that any change in the price of sugar in the next few months is likely to be downward. There is, thus distinct uncertainty as to the price of sugar this year; and after that, assuming that the war does not continue, there is no sign of any permanent

increase in the prices unless there is an alteration in feeling in Imperial matters, and steps are taken to ensure that the British Empire shall not be so dependent upon foreign countries for one of the staples of life, *i.e.*, by some form of preference for sugar, whether cane or beet, produced in the British Empire. This probably involves an increase in the price of sugar to the home consumer. Failing this, if the struggle is to be between cane and beet on equal terms, then we have to aim at producing sugar at as cheap a rate as the best cane sugar countries, *i.e.*, Java and Cuba. This can only be done by the exercise of unremitting care and attention to all branches of the cane industry, the selection of canes, their cultivation and manufacture. It is possible that if we only had some form of scientific taxation on the lines on which the Germans encouraged their beet industry, the sugar cane industry of the Colony would also make much more rapid strides than during the last fifty years.—PROCEEDINGS OF THE AGRICULTURAL SOCIETY OF TRINIDAD.

SUGAR PALMS.

In December last the Government of Bengal instituted enquiries as to the possibility of increasing the outturn of date-sugar and MR. ANNETT, the Agricultural Chemist, made a tour of the central districts of the Presidency which contain the principal date-sugar producing areas. The enquiries made generally indicated that owing to the decline of the date-sugar industry in recent years, a considerable number of date trees are annually left untapped. Another source of crude sugar is the sugar palm (*Arenga saccharifera*) which is very commonly cultivated in India and which is found wild in the forests of Burma and Assam. The possibilities of this palm as a sugar producer are discussed in the second article of a series in the June number of the INTERNATIONAL SUGAR JOURNAL, based on data furnished by MESSRS. O. W. BARRETT and C. W. HINES. The sugar palm is said to flower at the fifth or sixth year in the Philippines, where it is fairly common, and in the tenth year in India; and has an economic life of about fifteen years. The Philippine palm sugar trees are calculated to be capable of producing 20 tons of marketable sugar per year from an area of one hectare ($2\frac{1}{2}$ acres), containing not less than 150 and not more than 200 trees, and that for a period of 10 to 15 years. This, if not exaggerated, compares favourably with the 4 tons per hectare stated to be obtained in Java.

As with other sugar palms, it is necessary to take adequate precautions to prevent the tapped juice from fermenting before it can be worked up into sugar at the mill. Some experiments carried out with preservatives and methods of clarification showed that formalin was a very satisfactory preservative, as was also chloroform; but the best results appear to have been obtained with alcohol, added at the rate of 1 cubic centimetre to 40 cubic centimetres of sample juice. This had the advantage of acting chemically on some of the non-sugars and precipitating them. It is stated that the best method of clarification has been found to be to heat the sap to boiling point, whereby with the aid of the alcohol the albuminous bodies, pectins, etc., are precipitated and filtered off. The filtrate should then be treated with milk-of-lime of 15Be. until an alkalinity of 0·3 is reached. This is then carbonated to 0·3 acidity which causes another heavy precipitate to fall immediately,

leaving a perfectly clear, supernatant liquor. A beautiful, light, clear massecuite of 86 Brix is made from this sap, which begins to crystallize after three days, and at the end of five days is filled with sharp clear crystals and a very light coloured molasses. The sugar is easily drained off and washed to a high grade product with very little water.

The article referred to above states that, if a sufficient number of trees are available, there appears to be no reason why first class sugar and a very superior syrup cannot be made with a minimum expense in installing the necessary plant. Where a grove of sufficient magnitude is available, it would pay to have a vacuum evaporating apparatus, especially when a high grade of sugar is desired. With only a few trees, however, the usual copper open-train apparatus, as used in the maple sugar industry, may very well be employed, making high grade syrup and molasses sugars.

The sap from the Philippine sugar palm will, it is said, flow for two months at least, and sometimes for three. On an average, trees in full flow will give from $2\frac{1}{2}$ to 3 gallons per day, but this diminishes in time ; the average for 60 days' flow may be taken as $1\frac{1}{3}$ gallons, hence at that rate we have 80 gallons of sap of a specific gravity of 1·07, or about 850 lb. of sap containing 14 per cent. of sucrose, or 118 lb. of sucrose in the form of a molasses sugar of about 90 purity, which is equal to about 132 lb. of sugar. It should be possible to plant at least 150 to 175 trees per $2\frac{1}{2}$ acres. Taking the number as 160, that gives $9\frac{1}{2}$ tons on the basis of one tapping per tree per season.

Some analytical tests on three selected trees in the Philippines gave the average total solids in the sap as 17·07 per cent. ; the sucrose as 15·3 ; the reducing sugars as 0·02 ; and only a trace of acidity. The low acidity of the fresh juice is said to be a striking feature. Besides sugar, the juice of the sugar palm is readily manufactured into alcohol, and thence into acetic acid and impurities, or vinegar ; 342 parts of sucrose will yield 184 parts of alcohol, or 240 parts of acetic acid. Finally, there is starch, which is a product considered almost as profitable as sugar. The yield varies, but the Filipinos are reported to get as a rule from 1,100 to 1,650 lb. of starch per tree.

—Indian Trade Journal.

MANUFACTURE OF SUGAR.

CUBA.

J. F. CLARENCE.

There are factories grinding from 5,000 to 6,000 metric tons of cane per 24 hours. In spite of the great capacity of the mills, the juice extraction is not so large as is the case in Java, Hawaii, etc.

This may be accounted for in two ways. In Cuba grinding is exclusively done in the dry season, for should the rainy season set in before the crushing is finished, the cane still in the field would be past reaping. This would mean a complete loss for that harvest. It is evident therefore that factory owners have to direct all their efforts to getting the greatest quantity of material ground in the shortest time, and they pay minor attention to the quantity of sugar to be obtained from the crushed cane—a quantity which slow and careful treatment might increase. In addition to this the wages

paid in Cuba are very high, and amount to $1·00 or $1·50 (Rs. 3·00 or Rs. 4·50) a day, so that it becomes advisable to make the quantities of cane to be worked as large as possible, and let the inevitable wages cover as much output as possible. It is for these two reasons that the Cuban manufacturers, working with very powerful American mills and machinery, do not extract the same amount of sugar from the cane as for instance do the Hawaiian manufacturers with the same type of plant. Consequently, the loss of sugar in the bagasse exceeds that in other countries, while the loss in filter presses, molasses and losses unaccounted for in those factories where careful records are kept show nothing abnormal compared with factories in other centres.

The sugar crop begins in the latter part of December, but about the middle of January all the factories are working ; work continues until May in some provinces and until August in others. In the provinces of Pinar del Rio, Havana, Matanzas, etc., mills begin grinding at the end of December and finish in May, while further south, especially in Oriente province, the grinding season lasts from January to August. This depends entirely on the rainy season, which varies considerably throughout the Island.

The factories work day and night ; some stop every Sunday for cleaning while others only every fortnight.

There are generally two shifts of employees; in some factories they work six hours on and six hours off ; in others eight hours on and eight hours off ; and still in others, twelve on and twelve off.

In Cuba, the cane is cut close to the ground with a *machete*, a kind of cutlass, then stripped of its tops and cut into pieces two or three feet in length.

These are bound into bundles and piled up on ox carts which are driven to the factory, or the weighing stations in the fields, where they are weighed and transferred to the railway trucks for transportation to the mills.

No cane loaders are used in Cuba ; the cane is loaded on carts by hand.

The cane is transferred from the cart to the railway or tramway car in the same way as described in the Louisiana Report.

It is the custom to convey the cane from the fields to the mills by the estate railways, for which purpose extensive tracks with sidings run in all directions, along which the cane, when cut into lengths, is steadily conveyed to the factory.

Besides the methods already described in the Louisiana Report, there are others in use in Cuba.

Steel chains are placed across the floor of the car, the canes being loaded lengthways across the chains. When the car is in a position to be unloaded the ends of the chain are pulled out by a hooked rod, battens being placed along the sides of the car to facilitate this ; the ends of the slings are then joined and attached to the wire rope of a hoist ; the load is lifted and transferred by a travelling electric crane over a hopper ; a pull at a rope opens the attachment of the sling, and the load of cane is discharged. This form of unloader has been used by the Link Belt Engineering Company of New York. Another modification used by this company dispenses with the hoist altogether. Slings are placed in the waggon, as before. The waggons are furnished with drop sides, so that a continuous platform to the hopper is provided. The end of the sling remote from the hopper is attached to a

wire rope passing over a pulley block fixed to the roof of the shed. The waggon is anchored to the ground, and a pull on the hoisting rope turns the load of cane into the hopper. In another method the cane waggons are tilted, electric or hydraulic power being used, the canes falling into a pit or hopper similar to that above. The cane carrier is of the same type as described in the Louisiana report; it is always placed on the same level with the ground, so as to facilitate the feeding. It is independently driven by two small vertical engines.

FACTORIES.

The sugar factories of Cuba, especially those erected during the last ten years, are quite up to date in their design and equipment; the buildings are large and well ventilated, but unfortunately the steady increase in their capacity from year to year has given rise to overcrowding with machinery in some cases, and hence it is difficult to institute a thorough supervision—to the detriment of efficiency. The gravity system is extensively used in Cuba; the factories are built very high, sometimes up to four or five storeys, with the result that a great saving is effected in pumps and the power necessary for working them. It did not, however, appear to me to be practical, as the several storeys rendered the heat excessive and unbearable, especially during the summer months. This system, which is an ideal one theoretically, is not so in practice, as I have been able to experience. The latest factories I visited were very beautiful indeed; they are built up with plenty of air space and the machinery is so arranged that there is room for the machinist to reach any part of the engine he desires. When I left Cuba all the factories were making raw sugar of 96° polarization, which they sold to the refineries in New York and New Orleans. No white sugar was being manufactured. There is, however, a great tendency toward the manufacture of white sugar among the planters, and installations are being provided for that purpose.

CRUSHING.

The biggest and best arranged factories in Cuba have triple crushing and a crusher applying maceration, while it is quite an exception for a factory to have four or five mills in tandem. The mills are by several makers, READING, PRATT, FIVES LILLE, CAIL, etc., and in excellent condition. The hydraulic system for regulating pressure is used in all factories in the same way as described in the Louisiana report.

BOILERS AND FURNACES.

The return tubular boilers and water boilers are both used in Cuba. There are several types, among which are the BABCOCK and WILCOX, CLIMAX, etc.

The Dutch oven furnace with flat bars, and also the step grate furnace, are very much used, but the production of steam is not economically regulated and the furnaces work with a great excess of air, in consequence of which the quantity of bagasse, notwithstanding a fibre content of 10 to 11 per cent. in cane, is insufficient as fuel (and this while maceration is only sparingly applied, and only one sort of raw sugar is manufactured), so that wood as extra fuel is everywhere much used. The furnaces seem to be too large, and consequently the ratio of grate furnace to heating surface is great.

Automatic bagasse feeders are also used in Cuba. The Rotary bagasse feeder of the Link Belt Engineering Company is preferred and adopted in all the latest sugar factories; it works very satisfactorily and is a great labour-saving device.

JAVA.

J. F. CLARENCE.

The sugar industry is only carried on in Middle and Eastern Java—the Western boundary being formed by the Tjimonoek,—although some small plantations are met with west of this river. In middle Java the entire northern plain from the Tjimonoek to the limestone mountain of Rembang is given up to the sugar industry, and from the sea up to the foot of the middle mountains cane plantations are found. In East Java the sugar industry is more prominent in the extensive valley of the Brantas. In the alluvial north coast of the narrow eastern streak of that Island and in the tableland between the volcanoes in the residencies of Madioen and Mediri cane is grown.

The area planted with cane for the crop 1911 was 135,780 hectares = 335,591 acres. These figures stand for the number of hectares or acres that have been planted with cane for one of the harvests, and as no cane in Java is kept from the preceding year, but every year yields a new crop, they also represent the number of reaped hectares of this planting. The sugar production of Java in metric tons is 1,400,000 to 1,500,000 tons per year.

The grinding season lasts from the middle of May to the end of October.

Cane cultivation, as a rule, is carried on in Java on land which is not the planter's property, but is rented by him either for a single crop or for a comparatively small number of years, though sometimes he gets it on perpetual lease. Nearly all the cane ground by the sugar factories is planted under their own management, and only a very small part is bought from native growers, so that the manufacturers are cane planters as well, and both agriculture and manufacture are controlled by the same people.

Most of the sugar factories get their arable land by voluntary agreement with the population,—i.e., they hire land for one harvest only from the villages round the factories, and work them under estate control with their own labourers. According to the civil regulations, it is forbidden to hire more than one third of the arable land belonging to a village; moreover, a maximum planting area has been fixed for every factory, which cannot be exceeded when hiring. This is done mainly to assure enough food to the large population. The following scheme approximately indicates the succession of crops, although it is not an exclusive sample. Sometimes manioc or some other crop is planted instead of rice, so that then only one rice crop finds its place between two cane harvests.

September	Cane crop
September to November... ...	Beans, maize, etc.
November to April	Rice
April to November	Fallow, beans, indigo, etc.
November to April	Rice
April to September of next year ...	Cane, etc.

There are 198 sugar factories in the island of Java. Many of the factories are old and show evidence of additions and re-arrangement. The two newer factories visited are well designed and well equipped ; like the others, they are of the two storey type, with liberal use of space, and present an excellent appearance. The majority of the mills have either one or two sets. An attempt to work with three sets in one factory did not prove successful.

CRUSHING.

In Java an occasional crushing is seen, but most of the factories have triple crushings preceded by a crusher, and the newer factories have a crusher with quadruple crushings. These newer mills are supplied by Stork and Company or by one of the English makers. They are well built mills, and powerful.

The most striking and interesting feature of the factories in Java is the excellent mill work obtained with old mills. Taking into consideration the light mills, poor equipment and small percentage of maceration water in cane, the mill work in Java is excellent and compares most favourably with the work of more modern installations in Louisiana, Cuba, and Porto Rico.

There are few mills equipped with hydraulics. It seems the general opinion in Java that no better extraction is secured with hydraulics. In the tests made with and without hydraulics, no differences in the results were found. This is due, of course, to the even quality of the cane. It is the practice to grind one variety of cane at a time and change the setting of the mills to suit the next variety. As most factories grind two seedling varieties, namely J—100 and J—247, this is a simple matter, but would be out of the question in other countries where many different qualities of cane are ground during 24 hours. It is evident that the nature of the cane has a considerable influence in the milling results. The general practice of milling appears to be exactly opposite to those in vogue in Cuba and Porto Rico. It is usual in Java to run the mills as slowly as possible. One and a half to two revolutions per minute is the common practice corresponding to a peripheral speed of 14 to 18 feet per minute. The desire is to secure a heavy matt and to have it under pressure as long as possible. All the sugar men in Java are of opinion that the slower the speed of the mills, the better the extraction.

No scrapers are used on top rolls. It is considered advantageous to have a small amount of bagasse clinging to the roll. Small scrapers about three inches wide are often used at each end of the roll to prevent building up at the flanges and in cases where there is a tendency to build up, a light hanging scraper is used, merely to remove the excess. Many systems of grooving and cutting are employed, all with the same purpose of securing a good feed.

It is the general custom to turn the rolls down and regroove them for each crop.

The system of returning last mill juice for maceration is almost universal in Java.

BOILERS AND FURNACES.

The fire-tube boilers are used almost exclusively in the Java factories. There are a few water-tube boilers in use, but they are not liked.

The boilers used in Java are similar to the standard horizontal return tubular boilers, except that they have two long water drums attached to the bottom. These drums vary from 18 to 24 inches in diameter, and are set at a slight downward slope towards the back. They are connected to the main shaft by two uptakes, one in front and one at the back. The advantages claimed for these drums are that they increase the circulation of the boiler and also hold in reserve a large amount of hot water to take up the changes in load. The only disadvantages are that they cannot be made large units—about 300 h.p. being the limit,—and some trouble has been experienced with

the water drums bagging and warping, due to the high temperature they are subjected to. The step grate furnace is universally used. It is a long narrow grate set immediately in front of the boiler and supplied with blanking off plates which are used as needed. The upper steps are generally blanked off, and when working with a small supply of bagasse more are closed. This closed portion serves as a drying space, so that bagasse burns freely in the lower section, and at the same time the open steps are always covered with fuel and excess supply of draft is prevented.

The proper mixture of air and partly dried bagasse makes a short flame so that long combustion chambers are not necessary. The principal kinds of fuel burned in the sugar factories of Java are bagasse, wood, cane trash, and oil residue.

Generally bagasse suffices as fuel; some factories have a great quantity of bagasse, and run on nothing else during the whole grinding season.

Most of the bagasse is burned just as it comes from the mills. Factories that have an excess of bagasse generally sun-dry it before storing. In some places they make a practice of sun-drying the bagasse, with a view to increasing the fuel value. Bagasse from the mills is carried into the yards in bamboo baskets. This bagasse is spread all over the ground and native women are employed to walk and stir it occasionally. It is, however, questionable whether the increase in the fuel value of the bagasse pays the cost of drying in this way.

It is common practice to haul in cane trash from the fields to be burned in the furnaces. This trash is burned in separate furnaces, on account of the dirt and high percentage of ash. A labourer is constantly kept cleaning the grates.

The fuel oil generally used in Java is a thick residue of crude oil left after the lighter distillates have been taken off. There are three ways of burning this oil residue in Java. One is to burn it in an oven behind the grates; this method is claimed to be very economical by the engineers of Java, but as no tests were made to bear out this claim, it is impossible to say how far this is true.

Another method is to pour the oil on the bagasse as it is fired. This is done only when a small amount of extra fuel is needed, but this method is very wasteful of oil.

The third method is to burn in the same chamber with the bagasse by atomizing it in a steam oil burner. This is the same method as used in Louisiana. None of the factories have a separate boiler and furnace for burning oil, as the amount of oil to be burned is so small that it would not pay.

The bagasse is fed by hand and the opening kept closed with a good supply of bagasse. The flues are generally built in the boiler setting, running along the back of the boilers to a single brick or concrete chimney.

These chimneys vary from 120 to 150 feet in height.

For a 1,000 ton factory the diameter of the chimney is about 10 feet. They give a draft of $\frac{1}{2}$ to $\frac{3}{4}$ inch of water. Induced draft fans are used in a few factories. The only advantage which the engineers claim for the induced system is that the amount of draft could be better controlled than with a stack and damper.—BULLETINS OF THE DEPARTMENT OF AGRICULTURE, MAURITIUS.

INFLUENCE OF THE DIRECTION OF THE ROWS ON GROWTH OF BEET.

The following extract is taken from the Monthly Bulletin :—

So long as the soil was bare of vegetation the influence of the direction of the wind was hardly felt. In proportion as the sugar beets grew and the foliage developed and shaded the land, the direction of the lines of cultivation began to have a more appreciable influence. Winds travelling in a direction parallel to the lines lost little of their velocity as they met with little resistance between the wide rows. They displaced the masses of air saturated with moisture close to the soil, and passing between the lines they could absorb a greater quantity of water in proportion as the masses were further from the saturation point. The behaviour of currents of air travelling across rows of beets was very different, and since the distance between the plants was only half that between the rows, the force of the wind was considerably diminished. And as the plants were arranged on the quincunz system the wind was obstructed by the mass of leaves; it was obliged to rise and pass over the rows without disturbing the stratum of air between the rows. It is certain that the cool north winds and the warm south winds that are relatively frequent especially at the period when the crop has the greatest need of water, have acted prejudicially on growth in the rows of beets arranged in this way compared with the effect of east and west winds. These influences of the position of the rows were further accentuated by the shade which was also determined by the direction of the lines.

Assuming that, under the given conditions, the quantity of water present determines the rate of production of organic matter, it follows that the yield of the lines running east and west should be higher than that of the lines running north and south. The results obtained verified this supposition. It is therefore beyond doubt that a change in the direction of the lines may cause a diminution or an increase in the yield of organic matter. Marek, who worked with much larger plots, was also led to the same conclusion.

To show the economic importance of these results, the writer has calculated the yields per acre under the different systems.

The same variety of sugar beets sown in lines east and west—all other conditions remaining the same—gave a yield exceeding 16 cwts. per acre or about 7 per cent. the yield obtained with lines running north and south. The difference in the yield of sugar exceeded 2·32 cwt. per acre, and in the yield of leaves exceeded 103 cwt. per acre or 71·5 per cent. in favour of lines sown east and west.

Estimating the value of 1 cwt. of beets at 10*d* and 1 cwt. of fresh leaves at 2*d*, the value of the above increases is $(16 \times 10) \times (103 \times 2) =$ £1 10*s* 6*d* per acre. The profit is obtained without expense by the simple process of changing the direction of lines of seeding.

It is, therefore of great importance for the agriculturist to study the question of the direction of the lines of cultivation. The best arrangement should be determined for each locality, since local conditions such as proximity to mountains and large areas of water exert a considerable influence.

TOBACCO.

THE TOBACCO BEETLE (LASIODERMA SP.)

In view of enquiries received as to methods of controlling this beetle, the following *resumé* of an article appearing in the Philippine Agricultural Review by Mr. David Mackie, Tobacco Inspector, should prove useful to those who are troubled with the pest.

The insect is found in all parts of the world and, though known as the Tobacco beetle, attacks many other products (ginger, chillies, &c.) as well as herbarium specimens. It particularly affects cigars and prefers the milder and lighter leaves. It is the mature beetle that causes the damage by boring holes and depositing eggs in the cavities so formed. These eggs hatch in about 11 days and the young grubs continue boring about in the cigar.

The beetles also lay their eggs in the baled tobacco, and in this way the trouble may begin before the manufacture of the cigars.

The control of the insects as carried on in the U.S.A. for the last 10 or 15 years consists of subjecting the cigars to the fumes of some poisonous gas that will kill the beetles, grubs and eggs. Of these gases hydrocyanic acid gas has proved the most effective, though the greatest care should be exercised in its use owing to its highly poisonous nature. It is prepared by adding cyanide of potassium to sulphuric acid diluted with water ; 15 grams of the cyanide per cubic metre of space is sufficient to destroy the beetles. The amount of acid necessary is $1\frac{1}{2}$ times that of the cyanide, and water twice the amount of acid. Thus for a case of 2 cubic metres we would require 30 grams of cyanide, 45 grams of sulphuric acid and 90 grams of water. A graduated vessel of sufficient depth (to prevent overflow as the result of violent agitation which takes place) is the most convenient generator. The water should *first* be placed in the generator and the sulphuric acid added. (Do not add water to acid.) This gives rise to considerable heat. The cyanide is then tied up in paper and placed in the generator. The mixture will be found to froth and bubble while a whitish gas escapes. The gas is very poisonous and must not be inhaled on any account. The case in which the cigars are put should be airtight and when finally opened should be left so for at least 15 minutes before the cigars are taken out. The cigars may be made into bundles and placed on wire trays.

It is recommended that the case be lined with tin fitted with clamps and pieces of extra heavy felt attached to the edges where the covers fit. After closing, strips of paper should be pasted along the edges. The case communicates by a piece of 1 inch hose with the generator box of the same capacity. In the latter an observation glass panel may be inserted in the door.

The cyanide inserted in a paper bag may be suspended inside the generator box by a string running out through a small hole in the cover ; the generator with the water and acid can then be placed in the box just under the suspended cyanide and the door closed and all crevices sealed with strips of paper. Everything being ready the cyanide is lowered into the vessel. A few seconds is sufficient for the cyanide to eat through the paper ; then follows violent agitation and the evolution of mist-like fumes which will pass into the case in which the cigars are placed and kill both beetles and eggs. A case of the size mentioned is sufficient for treating about 6,000 cigars.

Cigars exposed to gas for 24 hours and aired for 5 minutes had no trace of any odour or possessed any objectionable flavour. The treatment costs very little.

FIBRES.

AMERICAN COTTON IN INDIA.

It will require some investigation and a careful examination of any facts that may have been observed to determine whether there is really truth in the suggestion that the difficulty of cultivating American cotton in India is due to the deteriorating influence of the indigenous varieties of cotton. Some species being indigenous in America and others in India, nothing would appear simpler than to cultivate the former species in the latter country or the Indian species in America. Experiments on this subject have for many years and at different times been made, both by the East India Company and individuals, but with the simple exception of what is called Bourbon cotton in the Tinnivelly district, no permanent success has attended them. Without referring to any recent results that may have been obtained, it is an important question to ascertain the cause or causes of this failure. In looking over the chapters of the cultivation of cotton, pp. 78 and 312, in Royle's Essay on the Productive Resources of India, we find that numerous experiments have been made on the subject; that the attention of the Directors of the East India Company was called to it as early as 1788; that seeds, with a machine for cleaning cotton, have been sent to India; and that a cotton farm was even established in the last century. So, again, in 1810, 1813 and 1818; and in 1840 Captain Baylis, who had returned from America with 10 experienced planters, was sent with them to India to cultivate American and Indian cotton in the American method in different parts of that extensive empire. In addition to this, we find the Agricultural Society of India and numerous individuals making experiments with the same object in view. Success has certainly not been in proportion to the efforts made. This cannot be because American cotton will not grow in India, for the complaints in some places are that it grows too much. We cannot believe that all the experiments have been unskilfully performed in a country where Indigo, Poppy, Sugar Cane, Mulberry and Rice are successfully cultivated. We suspect, therefore, that the causes of failure in producing an article suited to the European market must be of a very general nature to have been productive of so many similar results. And as these results may depend upon many different parts of the culture being carefully attended to—that is, the growth, the gathering the crop, the cleaning the cotton, the proper housing, and the careful packing—it is a question whether the people pay equal attention to every part of the culture, although each is of equal importance. It is probable also that in so wide a sphere of experiment, and where there are considerable differences of climate, the same causes may not be those which are the most influential in all the different situations; for instance, the soil may be too rich in one and too poor in another situation; the winds too violent, or the cold too great; the moisture excessive, or the dryness intolerable.—Extract from The Gardeners' Chronicle, August 2nd, 1845.

PHORMIUM TENAX IN NEW ZEALAND.

W. H. FERRIS.

This plant furnishes the only true native product of commercial importance in New Zealand. Rich harvests of fibre are still being obtained from the native fields, and though the only cultural treatment is the removal of surface water by drains and canals, the industry supports more labour per acre than any other crop produced in the country. At the present time 182 mills are in operation employing 3,276 men, of whom the annual wages total £400,000. The area of land occupied by the crop is about 65,130 acres, valued at £1,332,500 and the capital invested in the mills is £314,460.

One crop is obtained every 3 years at an annual maintenance cost of £1 per acre. The yield of leaf is 15 tons per acre, equivalent to about 1½ tons of fibre and about 3 cwts. of tow.—MONTHLY BULLETIN.

ACETIC ACID.

Considerable alarm arose among rubber planters when on the outbreak of war it was realised that supplies of acetic acid, almost all of which came from Germany and Austria, were likely to run short. MR. CAMPBELL, who was at that time Acting Government Chemist, immediately began investigating the question of being able to provide acetic acid or some substitute locally, and numbers of private investigators also set to work on the same problem. Cocoa juice, coconut water, and coconut vinegar were all found to be suitable coagulants, especially coconut water which is now being regularly used on some rubber estates. At Peradeniya pyroligneous acid from the destructive distillation of wood and of coconut shells was produced by an improvised still and the results made public. Supplies of acetic acid soon began to arrive from England and the urgency of the question passed, but results which will probably prove of permanent benefit to the Island remain. Acetic acid can be made cheaply and in ample quantity from coconut shells. It is not sufficiently clear in colour for the coagulation of rubber that is to be made into first latex crepe, but good, clear smoked sheet can be and is being made in large quantities with it. Ceylon produces enough coconut shells to provide sufficient acid for all the smoked sheet made in the Island—perhaps in the whole East—and I think our resources in that respect may very likely be turned to good account. The cost of acid works out at much less per lb. of dry rubber with crude acetic acid from coconut shells than with the imported product. MR. BAMBER has shown that considerable economy could be effected by using acetic acid prepared from coconut shells over the imported product. He calculates that the cost of acid per lb. of dry rubber is 0·08 cent in the case of the crude product, as compared with 0·39 cent to 0·65 cent when ordinary acetic acid is used.—ANN. REPORT OF THE DIR. OF AGRIC., CEYLON, 1914.

FOOD PRODUCTS.

BANANA MEAL.

The IMPERIAL INSTITUTE JOURNAL for April-June last refers to this product which in view of the present high price of wheat flour has been thought of as a likely substitute. The analysis of a sample prepared in Jamaica goes to indicate that compared with maize or wheat flour banana meal contains a smaller percentage of proteins, and is consequently of a lower nutritive value : it also contains less fat than maize meal. In consequence banana meal does not compare favourably with either of the other farinaceous products named.

Frequent enquiries are received as to the practicability of preparing banana flour in this colony, but as long as the present demand for the ripe fruit as well as for the cooking plantain exists, there would be no object in preparing the meal for which there is no steady demand.

SUDAN MILLET.

In April four varieties of Durra (*Sorghum vulgare*), new to Ceylon, were received from the Sudan and planted at Peradeniya, where excellent crops were obtained. Seed has been distributed to Anuradhapura and to several other centres through the Agricultural Society. Good crops have been reared under the Agricultural Instructors, notably at Ambalantota (Hambantota district); at Balangoda and Hettipola, in the Province of Sabaragamuwa ; and at the Urugala, Tenna, and Ankumbura School Gardens, in the Central Province.

At Anuradhapura it has been grown side by side with eight central Indian varieties. The Sudan have better heads and a larger proportion of grain and straw than the Indian. At Peradeniya the results were not quite satisfactory in some respects. It was a wet season and some of the ears, especially those of the erect varieties, became mouldy from rain being caught in the glumes. The pendulous-head varieties did not suffer so much. Smut again appeared. The climate of Peradeniya is, I think, too wet for the crop to give the best results.

Sorghum has been known in Ceylon many years, but for some reason has not found favour as a chena crop. As long ago as 1882 it was reported as growing very well as a grain-bearing crop in the North-Central Province, the yield being good. The grain is wholesome and nutritious for both man and beast, and should prove a valuable acquisition to gardens in the dry districts of the Island.—ANN. REPT. OF THE DIR. OF AGRIC., CEYLON, 1914.

FIELD TESTS OF SOY BEANS, 1914.

This bulletin (CONNECTICUT STATE STA. BUL. 185) briefly discusses the uses of soy beans as a catch crop, green manure crop, seed crop, silage crop, and for hay for Connecticut farmers, and gives results of tests of 1914 that

were planned and carried out by H. K. HAYES and C. D. HUBBELL, showing analytical data and composition in comparison with corn and alfalfa.

Data of 19 varieties grown as forage show the total yields to range from 5,389 lb. to 21,240 lb., averaging 16,949 lb. per acre, and the dry matter to range from 1,247 lb. to 6,287 lb.

The protein ranged from 2·7 to 7·1 per cent. with an average of 4·8, fat from 0·7 to 2·6 with an average of 1·6, nitrogen-free extract from 8·8 to 15·5 with an average of 11·7, and fibre from 4·9 to 12·3 with an average of 8·6.

The highest yielding variety in grain produced 32·5 bushels per acre. Analyses of the grains show the protein to range from 36·8 to 45·5 per cent, fat from 14·1 to 19 per cent., ash from 5·2 to 8·6 per cent., nitrogen-free extract from 26·2 to 32·9 per cent., and fibre from 4 to 6·5 per cent.

The composition and digestible nutrients of soy beans, cotton-seed meal, and linseed meal are compared. Methods of planting soy beans are discussed briefly. The Hollybrook variety is recommended for Connecticut conditions as a crop for soiling, hay, or green manure.—EXPERIMENT STATION RECORD.

EXPERIMENT IN PLANTING SWEET POTATOES.

Towards the beginning of 1914 there appeared in the AGRICULTURAL NEWS (Vol. XIII., No. 310) an account of an experiment carried out in Montserrat by MR. W. ROBSON, the Curator of the Botanic Station, to test the value as planting material of sweet potato cuttings taken from sprouted tubers, as compared with cuttings taken from the vines in the ordinary way. This experiment though showing increased yields in the case of the tuber-planted crop did not indicate the phenomenal difference said to have been obtained in Cuba some few years previously and reported in the AGRICULTURAL NEWS, Vol. VII., p. 120.

With a view to obtaining more conclusive information, the Montserrat experiments were repeated last year and the results have now been forwarded to this Office by MR. ROBSON. In this second experiment the cuttings from tubers and from vines of the same variety were placed in contiguous rows on November 25 and reaped on March 31. With regard to the climatic conditions which prevailed, during the latter half of the period the weather was very dry, the total rainfall from planting to reaping being 12·71 inches, distributed as follows : from November 25·78 inches, December 5·46, January 3·42, February 2·87, March ·18 inch.

Considerable trouble was taken to conduct the experiments in most careful manner ; and the tuber cuttings and vines got an equal start. The results, however, were less conclusive than in the previous year. In the former experiment the percentage gained from tuber cuttings worked out at about 20 per cent., while in this experiment it was only about 9 per cent., with only four of the varieties showing appreciable gains. The variety Red Bourbon, which showed an average gain of 27 per cent. in the first experiment, showed no gain in the present one, but the increase in crop from White Gilkes was as much as below,

It will be seen that on the basis of these two trials it is very difficult, if not impossible, to decide whether any particular variety will give an increased yield as the result of either method of planting, and the results must be regarded as disproving the general application of the original Cuban trials in which a gain of 350 per cent. was recorded in the case of the tubers.

It is interesting to note that the Montserrat results indicate that Blue Belle and North No. 3 are good dry weather varieties. Owing to the small rainfall a large proportion of the Red Bourbon and other varieties that usually give the largest crops yielded in this case potatoes that were small and unshippable.—The Agricultural News.

THE CASSAVA INDUSTRY IN THE WEST INDIES.

Mr. A. Vyvyan Board has called attention to the commercial possibilities of cassava. Cassava starch, he pointed out, was a comparatively expensive product, which must be sold in England at from £11 to £15 per ton to show a profit. Cassava flour, on the other hand, such as was being made in Trinidad, could be sold at £7 per ton in the English market, and on account of its lower price could enter markets closed to the higher grade product. Cassava was a competitor of maize, and in fermentation industries, such as brewing and distilling, had a great advantage over maize in that it was almost entirely free from oil and albuminoids. Oil had to be extracted from maize before it could be used for this purpose, especially in the case of brewing. The average amount of carbo-hydrates in maize was 60 per cent. and in cassava flour 84 per cent. Speaking of the small factory which had been erected at Palmiste, Mr. Board said that the process employed was to put the roots when they entered the factory into a rotary cleaner. The woody parts were then cut off, and the trimmed roots passed through a disc cutter, where they were cut into small pieces. These were subjected to considerable pressure, which removed about 15 per cent. of the moisture, starch being recovered in the ordinary way from the moisture thus expressed. The pressed cassava was then dried and ground into flour. Mr. Board considered that with cassava at £1 per ton, a very profitable business could be worked up.

Mr. W. G. Freeman, the Assistant Director of Agriculture, dealt with the agricultural side of the question. Cassava was of advantage as a catch crop, and he quoted an instance in which 58 tons grown in this way had cost, delivered a mile away, $4·11 per ton, the yield per acre being 5·63 tons. As a main crop he estimated that eight tons an acre could be grown, and it was reasonably expected, from what had been done elsewhere, that the cost would not exceed £5 to £6. He also pointed out that cassava was useful as a rotation crop for canes, these being grown for six years, then cassava and corn until the beginning of the eighth year, then a leguminous crop, with a return to canes in the ninth year.

The question of a cassava industry was again brought up and discussed atthe February meeting of the Board of Agriculture, when Professor

CARMODY referred to the Cassava Starch Factory at the Carenage, which was far in excess as regards power of the cassava obtainable. An account of this factory is given in the BULLETIN, in which it is stated that with 25s. per ton paid for roots, a satisfactory price could be obtained for the starch in the United States.—WEST INDIA COMMITTEE CIRCULAR.

GROUND NUT CAKE.

The ground nut, earth nut, monkey nut or pea nut (*Arachis hypogæa*) is grown in most of the tropical and sub-tropical regions of the world, and to a certain extent in countries where a temperate climate prevails. The chief countries from which ground nuts are exported are, in order of importance, India, Senegal, Gambia, China and Nigeria. A slowly but steadily increasing production has taken place in the tropical parts of the British Empire in recent years. The chief importing countries for ground nuts, in order of importance, before the war, were France, Germany and Holland, and the most important crushing centres, also in order of importance, were Marseilles, Bordeaux, Dunkirk, Hamburg and Delft.

The ground nuts imported into the United Kingdom prior to the war were mainly used either in confectionery (as a cheap substitute for almonds and pistachio nuts) or as edible nuts; on the Continent they are chiefly used as a source of oil and of feeding cake for stock. The nuts are now being crushed on a small scale in the United Kingdom, and ground nut cake of British manufacture will be on the market shortly.

The oil is obtained either by pressing or extraction. The pressing seems to be carried out in three distinct stages: the first (cold) pressing gives an almost colourless oil of pleasant taste and smell which is largely used for table purposes and in the manufacture of margarine; the oil from the second pressing (either cold or warm) is sometimes fit for table purposes, but is mostly used for burning; and that from the third (warm) pressing is a yellowish oil of less pleasant taste and smell, which is used in the manufacture of soap. When the oil is only to be used for the manufacture of soap the whole is usually extracted by chemical means, and as the nuts must then be previously ground, the residue after extraction is in the form of a meal.

Only in the case of the very best ground nut cake are the nuts shelled in Europe, and in this case most of the seed-coat is removed in the process. Most of the cake is made from Indian-shelled nuts, in which case only the shell is removed, not the seed-coat and germ. Ground nuts obtained from China and Africa are, as a rule, of much better quality than those exported from India. The last-named, owing to the native practice of wetting them, generally arrive in Europe in bad condition and yield a dark-coloured cake, much of which can be used only as manure. Efforts are, however, now being made to improve the quality of the Indian exports.

COLOUR.

Samples of the cake vary in colour from an almost pure white to grey or grey-brown. The more nearly the colour is pure white, the better is the sample and the smaller is the likelihood of adulteration. (Good cold-pressed cake from decorticated nuts is white or light grey-brown). Yellow or grey-yellow cakes and dark-coloured meals should be suspected of being the produce of nuts mostly spoilt by fermentation and possibly adulterated. Good cake from unspoilt nuts has a sweet, pleasant, bean-like taste, and a fresh, oily smell; the latter, however, is easily lost as the fat has a great tendency to go rancid (some experimenters, however, think that cake with a high fat content keeps better than one with a low). The effect of warm pressing is to give the cake and meal therefrom a red appearance, as the reddish seed coat is then broken up finely, whereas in cold-pressed cakes it is present in large pieces and recognisable as red spots.

COMPOSITION.

Analyses of decorticated ground nut cake show that this feeding stuff is very rich in protein. Rufisque cake is usually sold in Germany with a guaranteed minimum of 48 per cent. of crude protein (over 50 per cent. is often found), with 6 to 9 per cent. of fat, about 25 per cent. of carbohydrates, and less than 1 per cent. of sand; while ordinary decorticated samples are usually guaranteed to contain 46 per cent. of crude protein and 7 to 8 per cent. of fat, and they contain in addition up to 9 per cent. of fibre and from 2 to 3 per cent. of sand.

The following analyses are given by various authorities:—

	Moisture	Oil.	Crude Protein.	Carbo-hydrates.	Crude Fibre.	Ash.
GROUND NUT CAKE:	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
KELLNER:						
Decorticated	9·8	9·2	44·5	23·8	5·2	7·5
Rufisque	9·0	7·0	50·8	24·3	4·4	4·5
POTT:						
Decorticated	10·00	7·30	48·00	24·50	5·00	5·2
Undecorticated	11·00	9·00	31·00	19·50	23·50	6·0
VOELCKER:						
Decorticated	10·43	8·17	48·32	22·99	4·67	5·42
Undecorticated	11·60	7·17	28·50	28·06	18·97	5·70
SMETHAM:						
Decorticated	10·60	7·73	49·31	21·71	4·70	5·95

DIGESTIBILITY.

As regards digestibility it seems to be accepted that both protein and fat in decorticated ground nut cake are about 90 per cent. digestible on the average; the figure given for the average digestibility of the carbohydrates varies—it has recently* been placed at 93 (KELLNER's figure is 84). The following are KELLNER's figures for digestible constituents of decorticated cakes compared with those for other foods:—

	Oil	Crude Protein.	Carbo-hydrates.
	Per cent.	Per cent.	Per cent.
Ground Nut Cake, decorticated ...			
Ordinary	8·30	40·00	20·00
Rufisque	6·30	46·70	20·60
Decorticated Cotton Cake ...	8·46	35·26	17·42
Undecorticated Cotton Cake ...	5·11	16·94	17·68
Linseed Cake	9·20	25·80	26·52

According to VOELCKER the ash contains 7·62 per cent. of nitrogen, 2·0 per cent. of phosphoric acid and 1·5 per cent. of potash. The residual

* Illustriertes Landwirtschafts Lexicon, 1910.

manurial value is high: adopting HALL and VOELCKER's scale, the value works out at 66*s.* 2*d.* per ton if made into dung, and 89*s.* 1*d.* per ton if consumed on the land. These are higher figures than for any other food shown in HALL and VOELCKER's Tables. Ground nut cake used in England in the past has at times contained excessive amounts of sand and earthy matters.

FEEDING VALUE.

Decorticated ground nut cake would form a suitable substitute for decorticated cotton cake, and can be used for all classes of stock to add to rations which are poor in protein. If of good quality it is readily eaten by all animals. The best results are obtained from its use when fed in moderate quantities and introduced into the ration gradually, in which case it has no effect on the taste of milk or meat.

For *dairy cows*, up to 3½ lb. per head per day can be recommended; the milk and butter are said to suffer in flavour with larger quantities; with small quantities some experimenters report a favourable effect on the quality of the butter. Ground nut oil was added to the ration of dairy cows in an experiment at Wye College without producing any appreciable difference in the yield of milk or percentage of fat. From 2 to 4 oz. per head per day improved the flavour of winter butter, but larger quantities made the cream difficult to churn and the butter was soft in texture.

Fattening cattle may be given up to 4½ lb. per head per day; and fattening calves may receive up to 1½ lb. per head per day. Excellent results have been obtained in the Bremen district by feeding calves with a gruel made up with decorticated ground nut cake, separated milk and warm water. Experiments at Woburn in 1892 with fattening bullocks showed that the cake could replace beans in a mixed diet and give as satisfactory results.

Pigs may be given up to 2 lb. per head per day, and a firm bacon of good quality is said to result from the feeding. Care must be taken to begin with very small quantities.

It would probably be best not to give *sheep* more than from ½ lb. to 1 lb. per head per day.

For *horses* ground nut cake seems to have been found specially suitable, and numerous experiments have been made in which this food has satisfactorily replaced part of the oats ration for horses. Thus in a ration of 12 lb. of oats 4 lb. of the oats might be replaced by 2 lb. of ground nut cake, or 6 lb. of the oats by 3 lb. of ground nut cake. In Schleswig-Holstein it is usual to begin by replacing 1 lb. of oats by ½ lb. of ground nut meal, and gradually increase this amount. It has further been used in many cavalry regiments in the German Army with good results. If the cake is given to horses it is best fed crushed, and either spread out dry over their other foods or mixed with the latter.

Ground nut cake sometimes causes constipation; where this is found to be the case it could be remedied by regulating the other foods in the ration.

POSSIBLE DANGER FROM FEEDING GROUND NUT CAKE.

While the high protein content is largely responsible for the high feeding value of the cake it is also a source of danger, favouring the production of harmful decomposition products, though this can, as a rule, only occur when nuts in bad condition are used for making the cake. In a case of poisoning

of cows investigated at the Kiel Veterinary Institute the cause was found to be the presence of these decomposition products of the protein of earth nut cake. Decomposition is liable to set in where the nuts have been shelled before transport, but where it does occur it is almost entirely confined to Indian nuts and is due to the wetting of the nuts before they are shipped. Faulty storage of the cake or meal is also likely to cause decomposition. POTT insists that decorticated cakes of which the protein content falls below 47 per cent. should *a priori* be regarded with suspicion as being spoilt or coming from spoilt nuts ; and that suspicion should increase when the cake contains relatively much amide nitrogen and little sugar.*

Besides the protein decomposition products, cakes may contain rancid fat, decomposed starch, alkaloids, mould organisms and insect larvæ. There have been many instances of animals steadily refusing ground nut cake even though it appeared clean and unspoilt, and this may have been due to one or other of the factors mentioned. If the cakes have a rancid, bitter, or sharp taste they should certainly not be fed to animals ; and if there is any doubt on the point they should be cooked and fed to fattening and draught animals, and not to dairy cows, breeding animals and young animals.

Adulteration of the cakes and meals has been practised in the past, and inferior samples may be due to this cause. Both undecorticated cake and meal are more easily adulterated than decorticated cake, but the two former seem to be disappearing from the oil cake trade.

Numerous instances have occurred in which illness has been caused in animals owing to samples of decorticated cake containing castor oil seeds. These seeds may be present in consignments of nuts sent to Europe, but their presence is also possibly due to the cake being pressed on the same machines as castor oil seeds without the residues of the latter having been removed. A serious case of poisoning from this cause was reported in France in 1913, in which five cows aborted and one died through feeding on earth nut cake of the kind commonly used in France. A guarantee should be obtained from the vendor as to the absence of castor oil seeds from the cake.

Besides the possibility of spoilt and adulterated cakes, a third source of trouble in the past has been the presence of hairs on the cakes from the pressing cloths, though these hairs are usually easily visible on the outside of the cake.

Broken ground nut husks are frequently used to adulterate cakes and meals. The husks are also occasionally ground, mixed with molasses, and used as a cattle food. The product known in Germany as "ground nut bran" is generally a mixture of ground nut seed coats and husks.

Damaged and mouldy ground nut cake is used as a manure.

A leaflet giving statistical and commercial information regarding ground nuts can be obtained free on application to the Imperial Institute, and an article giving detailed information as to the cultivation, preparation, and uses of the nut will be found in the BULLETIN OF THE IMPERIAL INSTITUTE, 1910, Vol. 8, No. 2.—JOURN. OF THE BD. OF AGRIC.

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* Spoilt cakes were found to contain from 1·2 to 5·3 per cent. of sugar (reckoned on fat free organic matter) ; normal cakes from 6·2 to 9·1 per cent. Spoilt cakes contained from 0·3 to 0·5 per cent. of amide nitrogen ; normal cakes not over 0·34 per cent. Spoilt cakes showed an average fat acidity of 75·3 per cent. ; normal cakes 28·4 per cent.—(BULL. DE l'AGRIC., 1906, No. 7).

SOILS AND MANURES.

THE EFFECT OF SMOKE AND GASES ON VEGETATION.

A. L. BAKKE.

The following results are arrived at as a result of the above study :—

1. Gases and smoke have a detrimental effect upon vegetation.

2. The presence of vegetation in the vicinity of a manufacturing concern depends to a large degree upon its proximity to the plant in question. The territory reaching out from an industrial centre is marked out into various belts. Each belt has a certain characteristic flora that marks it out from the others.

3. An industrial city shows conditions that are similar to those of a single large manufacturing concern.

4. The effect of smokes and gases upon the leaves of plants concerns itself mainly with the assimilation process.

5. Certain species on account of their anatomical structure are more resistant than others.

6. As a means of prevention for an industrial city like that of Des Moines, Iowa, it is proposed to put in smokeless furnaces with tall smoke stacks, which will dilute the SO_2 to such an extent as to be harmless to the vegetation in general. Where gaseous emanations are peculiar to the product manufactured, special condensing flues must be provided.

7. The smoke from locomotives is largely prevented by careful firing. The real solution lies in electrification.—BULL. No. 54, IOWA STATE COLLEGE, AMES.

INOCULATION OF CROPS.

It was determined to make a trial of the new preparation of peat, introduced by PROFESSOR BOTTOMLEY, for the purpose of inoculating crops. An account of the method of preparation is given in the JOURNAL OF THE ROYAL SOCIETY OF ARTS, Vol. LXII., No. 3,199, March 13, 1914. It may briefly be stated that this consists of the formation, in the first place, of soluble humates, after which the material is sterilised and then inoculated with *azotobacter* and other nitrogen-fixing organisms. The necessary material was kindly supplied

by PROF. BOTTOMLEY, and an analysis of it gave the following results :—

Moisture	...	...	49·87
Organic matter	...	...	40·87
Mineral matter	...	...	9·26
			100·00
Containing nitrogen (total)...		...	2·16
equal to ammonia	...	...	2·63
Soluble nitrogen	...	..	0·53
equal to ammonia	...	...	0·64
Containing sand	...	...	3·66
.. lime	...	...	0·83

Previous experiments at Woburn having shown the advantage of heating ordinary Fen soil, it was determined to compare the effect of this with BOTTOMLEY's peat preparation in order to see whether any influence attaching to the use of the latter might not be derived purely from the organic and nitrogenous matters supplied.

The experiment was accordingly arranged as follows :—

1. Ordinary Woburn soil.

2. Ordinary Woburn soil, with BOTTOMLEY's preparation added in the proportion recommended by him, viz., eight parts of soil to one of the Peat.

3. Ordinary Woburn soil, with heated Fen soil.

In No. 2 the Peat preparation was added to the top six inches of soil, and in No. 3 the same bulk of heated Fen soil was mixed with the top six inches of soil. The Fen soil had been heated continuously for two hours at a temperature of 80°–100°C. The crops were barley, peas, and mustard, and the pots—which were in duplicate—were filled on March 31, 1914, and sown on April 8.

During the period of growth it was noticed that with mustard the Bottomley preparation and the Fen soil imparted a much darker green colour to the crop than did the untreated soil. Later on, the Bottomley preparation produced much thicker stems, and at the beginning of July, when the first crop of mustard was ready to cut, the effect was very marked. With barley the Bottomley preparation gave also a darker colour and a broader flag, and with peas a stronger growth and better colour. The Fen soil appeared to be without much effect in the case of barley and peas.

The first crop of mustard was cut on July 4th, and the second crop sown at once. This second crop showed much the same differences as were observed in the first instance, and was in due time also cut and weighed green.

The barley crop when ripe was cut and weighed, but the peas were very much blighted, an unsatisfactory crop resulting, and the results with peas must be taken with reserve. There was, however, no mistaking the better appearance and greener colour of the crop treated with Bottomley preparation,

The results were as follows :—

	Mustard. Weight of Green Crops.		Barley.		Peas.	
	1st Crop.	2nd Crop.	Corn.	Straw.	Corn.	Straw.
	Grms.	Grms.	Grms.	Grms.	Grms.	Grms.
1. Ordinary soil ...	59·6	12·3	18·1	25·5	0·70	10·9
2. Do. with BOTTOMLEY's preparation	163·3	20·6	19·6	33·5	10·1	16·9
3. Do. with heated Fen soil ...	71·8	20·0	14·0	27·1	3·5	12·5

From these results it is seen that the benefit of the Bottomley preparation was very marked in the case of mustard, a slight advantage accruing with barley, and, so far as can be judged, an advantage also with peas. The Fen soil proved slightly better than the ordinary soil with mustard, but not as good with the barley crop, and in each case it fell considerably below the Bottomley preparation.—JOURN. OF THE ROYAL AGRIC. SOCIETY.

LIME.

THE FORMS AVAILABLE FOR AGRICULTURAL USE.

W. S. HILL.

The manifold beneficial results attending the use of some form of lime on most agricultural and pastoral lands have lead to its widespread use during recent years. In order to encourage the use of lime for agricultural purposes the Government of New Zealand allows free railage to a distance of 100 miles. But few districts are beyond this distance from some available source of supply, and consequently most farmers have at their nearest railway station a cheap and efficient soil improver.

Lime or oxida of calcium is found in many forms and combinations. In natural deposits it is found in limestone, shell rock, papa rock, marl. Forms artificially produced from these are quick-lime and slake-lime. The three substances of highest efficiency and usually applied for agricultural purposes are :—

(1) Ground limestone.
(2) Unground burnt limestone.
(3) Ground burnt limestone.

It is sometimes difficult to determine which material will best suit the conditions and purpose for which it is required. The first consideration will be to ascertain the relative values of the three forms of lime by comparing

their qualities as soil improvers. The second consideration will be one concerning cartage and convenience in applying the material to the land.

Ground limestone is lime in the carbonate form, or chemically the carbonate of calcium.

Burnt limestone is lime in the "quick" or "hot" form, or chemically, oxide of calcium. It is made by burning limestone with wood, coke, or coal. The burning process simply drives off the carbon dioxide or carbonic acid gas from the limestone. Treating with pure substances 100 parts of limestone would yield 56 parts of burnt limestone or quick-lime. As the best limestone is usually from 90 per cent. to 95 per cent. pure, and the burning process is not always complete, it may be estimated that by burning the weight is reduced by from 35 per cent. to 40 per cent. For agricultural purposes $1\frac{3}{4}$ tons of ground limestone are taken as equivalent to 1 ton of burnt limestone in lime content. If this burnt limestone be exposed to water, rain, or moist air "water slaking" or falling takes place. The major portion of the compound formed in this process is slaked lime, or, chemically hydrate of calcium. If the burnt limestone be exposed to a comparatively dry atmosphere "air slaked-lime" or, chemically, carbonate of calcium, is formed. This is the same substance as the original limestone, only in an extremely finely divided condition.

Ground limestone will vary in value, depending upon the manure of the limestone from which it is obtained. A pure, white limestone will yield a more valuable product than one with an admixture of clay or sand. The degree of fineness to which a limestone is ground is of importance. This ensures a more even distribution, and enables many particles to be carried into the soil by rains. The higher the degree of fineness the larger is the surface exposed to the action of soil acids and other solvents. An excellent limestone ground in New Zealand contains 33 per cent. which will pass through a sieve with 10,000 holes to the square inch. Some limestones are so coarsely ground as to be somewhat like coarse bonedust or sand. To grind limestone much finer than from 30 per cent. to 40 per cent. to pass through the sieve mentioned would necessitate the installation of machinery which would greatly add to the cost of production.

Ground limestone is easy of application, does not deteriorate by keeping in the bags for a length of time, and is quite as efficient as, and cheaper than, burnt limestone for medium to light soils. The quantities applied per acre vary with the land and conditions. Heavy clay or sour soils would benefit by dressings of one to two tons, and even more, per acre. This may seem a large quantity, but it must be remembered that 2 tons per acre represents but 0·15 per cent. for the top 9 inches of soil. On medium and light lands, from 10 cwt. to 1 ton per acre would be considered a good dressing.

Underground burnt limestone or cob lime requires to be slaked before incorporating with the soil. This form of lime is preferably placed in heaps on the ploughed land during the winter months. If covered with some soil air slaking is reduced to a minimum. Should it be wished to hasten falling the application of water to the heaps will greatly assist. The slaked lime is then spread by means of shovels, and harrowed into the soil.

Ground burnt limestone, or quick lime is as a rule applied through a distributor. Its fineness ensures an even distribution, but its application is, as a rule, disagreeable, owing to its action on the face and hands. Burnt limestone, on account of its strong basic nature, is of the greatest benefit to sour soils or heavy clays. Its action is rapid, and on lighter lands would be inclined to be exhaustive. Its application would best be performed during the winter months, and if possible just before rain falls. The object of this is to ensure that the lime may be water slaked to a larger extent than air-slaked Owing to the readiness with which burnt limestone combines with water or the carbon dioxide of the air this substance cannot be retained in bags for long, as its rapid increase in bulk will cause the bags to burst.

The changes which take place when lime is applied to land under varying conditions are but little known. It would seem that a proportion of the lime would be converted into the bicarbonate of calcium, which substance is soluble in water. It may be in this form that the ground limestone is utilised as a plant food by leguminous plants. The bicarbonate of calcium would be thoroughly distributed in the soil by the soil water.

Ground limestone would seem the more suited for light and medium lands, especially over a long period of years. For heavy clay, sour, or heavy swamp lands, where cartage from the nearest railway station is expensive, in cases where it is wished to thoroughly prepare land for legumes, and for soils very rich in organic matter, the burnt limestone would seem more suitable.

In order to experiment for oneself and compare the lime and ground limestone, these should be applied in the proportion of 1 of the former to $1\frac{3}{4}$ of the latter. The results from liming are not always immediately apparent. The most reliable sign that the soil has benefited by the dressing with lime is the abundance and robustness of leguminous plants, and a distinct improvement in mechanical condition.—CANTERBURY AGRIC. COLLEGE MAGAZINE.

DYNAMITE IN AGRICULTURE.

MR. B. BUNTING in the F. M. S. AGRICULTURAL BULLETIN discusses the results of experiments in the use of dynamite by the Agricultural Department and arrives at the following conclusions :—

1. That dynamite is unequalled for breaking up hard-pan or layers of impervious subsoil, which not only prevent the roots from going down to the subsoil but interfere with the drainage.

2. It is most effective on heavy clay and hard laterite soils, and least effective on light or loose soils which offer no resistance to the explosion.

3. That it might be profitably employed in holing previous to planting, especially in heavy soils, half a charge of dynamite being sufficient for this purpose.

4. It may be successfully used in breaking up logs and tree stumps infected with termites in rubber clearings.

5. That the value of dynamite for cultivation is not doubted, but the high cost of the explosive prevents its more general use,

DRUGS.

POISONOUS PLANTS.

THEIR USE AND MIS-USE.

[*Illustrated.*]

While certain families of plants are characterised generally by distinct poisonous characters, others are distinguished by a remarkable freedom from poisonous traces. As an example of the latter may be mentioned the Natural Order *Cruciferæ*, to which belong the cabbage, cauliflower, turnip and other useful vegetables. To the former belong *Aroideæ*, *Euphorbiaceæ*, *Apocynaceæ*, *Asclepiadeæ*, *Urticaceæ*, *Solanaceæ*, *Umbelliferæ*, *Longaniaceæ*, and others. Although these latter contain some of the most virulent poisons of the vegetable kingdom, yet some of them furnish wholesome food products, as for example the natural order *Solanaceæ*, which yields some of the most powerful poisons, as nicotine, atropine and hyoscyamine, and also includes such excellent vegetables as potatoes, brinjals and others. The order *Leguminosæ*, which furnishes nutritious peas and beans of numerous kinds, includes also some very poisonous members, as for example the Sassy-bark tree *Erythrophlæum* of West Tropical Africa, and the famous ordeal poison bean of Old Calabar, *Physostigma venenosum*. It is best, therefore, to regard all unfamiliar Leguminous plants with suspicion until proved to be innocuous. It may here be mentioned that practically all plants contain certain traces of poison, so that the term "poisonous" has no precise definition and is only a matter of degree. Then again some poisons vary somewhat in their effects on individuals, according to the physical conditions of the latter, and this is more especially the case among animals. Some poisons are only harmful if injected into the blood, and pass without ill-effects if swallowed. Such, for example, is the seed of the Indian Liquorice, or Olinda-wel (*Abrus precatorius*) and certain other Leguminous seeds. In some instances the poison may be dissipated by boiling and careful washing; thus Manihot ("Manyokka") roots, which contain prussic acid when raw, are rendered a wholesome food by careful preparation. Some people consider that the boiling of suspicious tubers with salt is a safe precaution. In many cases the noxious properties are distributed throughout the whole plant, in others they are mostly confined to certain organs, some being peculiar to the roots, others to the leaves or seeds. Thus in *Strychnos* the poison (strychnine) is centred almost entirely in the seed, as is also the case with certain Leguminous species. In others the virulent qualities are contained in the milky juice, as in the Upas-tree and members of the families *Euphorbiaceæ*, *Apocynaceæ*, etc. Any plant which possesses a milky juice should be treated with caution until more is known about it

VALUE OF POISONS AS DRUGS

A fact of very great importance to mankind is that plants possessing poisonous qualities have very often great medicinal value, some of the most deadly poisons being among the most important and indispensable drugs, as, for example, opium. There are thus probably few poisonous kinds which do not also possess useful properties either therapeutically or antiseptically.

The powerful poisonous seeds of *Strychnos*, already referred to, furnishes the valuable drug strychnine, the *Datura* or "Thorn Apple" yields hyoscine and atropine, while the small seeds of the poisonous Umbelliferous plant, *Carum copticum*, produces thymol, a useful drug in demand for anchylostomiases treatment and an antiseptic said to be better than carbolic acid. The poisonous *Gloriosa superba*, "Niyangala" of the Sinhalese, has recently shown on chemical analysis to possess an alkaloid drug which has hitherto been known to occur only in Colchicum, a small plant of northern Europe. Poisonous plants are, therefore, always worthy of careful investigation, not only on account of their possible medicinal value, but also from the fact that they are liable to be used for criminal purposes, or to be the cause of serious accidents to human or animal life.

ARROW, OR DART POISONS.

The art of poisoning arrows or darts for use with a bow or blow-pipe as a weapon for defence or offence does not appear to have been practised in Ceylon, unlike other countries, to any great extent except by the aboriginal Veddahs. Therefore the knowledge which the Sinhalese possess of the poisonous plants of the country is more associated with other causes than arrow-poisoning. In other tropical regions, however, as Africa, Malaya, etc., the reverse is the case, and most vegetable poisons are known to the natives from their use for the latter purpose. In Ceylon there are certain poisonous species which appear to be not employed for any other but criminal purposes, while there are others which, not being well-known, are not infrequently the cause of accidental poisoning, as the tuberous root of the above-mentioned *Gloriosa superba* ("Niyangala"), the fruit of "Hondala" (*Modecca palmata*), and the yam of a wild species of Dioscorea (*D. tomentosa*). It is worthy of note that certain poisonous plants which are notorious in other countries are here overlooked or passed as innocuous, as for example the Upas-tree of Malaya and the Dumb-cane of Brazil. The Upas-tree furnishes the arrow-poison *par excellence* of Malaya. A correspondent writing recently from Sumatra states that during the last intertribal war of the interior, men from the mountains came down to Kwala, a distance of 100 miles or more, to collect the juice for the poisoning of their blow-pipe darts.

ANTIDOTES.

Some knowledge of first aid measures in the case of vegetable poisoning is especially useful in the tropics, where risks from the accidental use of dangerous plants are sometimes considerable. As a rule the first step, until a physician arrives, should be to empty the stomach by means of an emetic, as by a liberal dose of mustard and warm water. If this is not at hand, tickling the throat with a feather or a blade of grass should be tried persistently. Here are some recognised official emetics: zinc sulphate, 10 to 30 grains in half tumblerful of warm water ; copper sulphate, 5 to 10 grains in same quantity of warm water ; ipecacuanha powder, 30 grains in a wineglassful of water ; ipecac. wine, 6 drachms in a tumblerful of warm water; common salt, 2 tablespoonfuls in a tumblerful of warm water. In the case of fungi poisoning some doctors especially recommend the last named emetic, to be followed, as in other cases, by a dose of castor oil. After the stomach is thoroughly emptied, a stimulant in the form of brandy, whisky or strong coffee should be administered, while keeping the feet warm and the patient lying down should also be attended to. Curiously enough one poison has often the effect of counteracting

another, and the doctor will probably give hypodermic injections of atropine or other strong drug to act on the heart or to deaden pain. The Sinhalese have as a rule great faith in the efficacy of simple vegetable antidotes or charms, of which numerous kinds for different purposes are recognised. Those for snake-bite are varied and numerous, one of which, for example, is banana juice, the virtue of which, it is stated authoritatively, depends entirely on faith. Certain animals are popularly supposed to find their own remedy for poisons ; thus the mungoose, if he should get bitten by a cobra. promptly resorts to the root of a plant which has been named in his honour, *Ophiorrhiza mungos.* In native medicine numerous antidotes or charms are also given as remedies for hydrophobia. These often consist of roots, but sometimes of seeds or portions of grotesque stems.

ORDEAL POISONS.

In former times, persons suspected of witchcraft or crime were made to eat portions of certain poisonous plants, or confess the alleged offence; if the accused died from the effects, they were considered to be guilty ; while if they vomited the poison they were held to be innocent. So strong was the belief in the mystic discriminative power of these poisons that the innocents gladly availed themselves of the test, while the real culprits would in many cases rather confess their guilt than submit to the fatal ordeal. The custom still prevails among some tribes in Africa, and so persistently was it followed, in spite of civilised law, in Old Calabar that the British Government ordered the extermination of the famous ordeal bean of that country.

Hippomane Mancinella is the deadly Manchineal tree, of the Natural Order *Euphorbiaceæ*, common in Venezuela, Panama and in some of the West Indian Islands. The acrid milky juice of the tree is of a virulent poisonous nature, and has earned for it a reputation as notorious as that of the Upas tree of Java. Fabulous tales are recorded of its fatal powers, it being considered that even grass will not live under it. But the explanation of the latter is probably found in the fact that the tree is usually found on sandy sea-shores

Erythrophloeum guineense, the "Sassy Bark" of Sierra Leone, is a leguminous tree, whose poisonous bark is administered in remote regions by the natives as an ordeal poison.

Antiaris toxicaria is the famous Upas tree, belonging to the very large and varied order of *Urticaceæ.* Few trees have been more widely exaggerated in regard to supernatural powers than this, which has been credited with giving off poisonous fumes fatal to animal life. Criminals condemned to die, it has been recorded, were offered the chance of life if they would go to the Upas tree and collect some of the poison, and "of those who accepted the offer only two out of twenty returned alive." Those who were lucky enough to escape reported that "they found the ground under the trees covered with the bones of the dead." There is a good specimen of this tree, some fifty years old, in the Royal Botanic Gardens, Peradeniya, close to the entrance, and is not only visited and closely inspected by numerous visitors every year, but even stabbed and punctured by the more daring. The tree is not, however, as innocent as may appear from this, for it has been proved by experiment to possess a virulent poison (antiarin) which if injected into the blood is rapidly fatal, and is consequently in great demand by the natives of Malaya and Java for poisoning their arrows.

Physostigma venenosum is the "Ordeal Bean" of Old Calabar, above referred to. It is a strong twining climber, producing large oval dark brown seeds, which are poisonous and have, as stated, long been employed by the natives as an ordeal poison.

Cerbera Tanghin, of the Natural Order *Apocynaceæ*, is a small tree with a milky juice whose fruits are the Ordeal Poison of Madagascar.

GENERAL POISONOUS PLANTS.

Acokanthera spectables. (N. O. *Apocynaceæ*). African arrow-poison. A large shrub of tropical Africa, bearing white scented flowers. The milky juice obtained from the roots and wood are used by natives in Africa for poisoning their arrows.

Abrus precatorius (N. O. *Leguminosæ*).—"Olinda-wel." *Sinh.*, commonly known as "Indian liquorice." A slender perennial climber, the bright red and black seeds of which are an acrid poison, and are often used criminally in India for killing cattle. The method of procedure is to powder the seed into a paste and apply this by means of a dart or arrow aimed from a short distance, the results being generally fatal within 24 hours. The poisonous property is believed to be in the red covering of the seed. Boiling renders the seed harmless. The roots and leaves are much used in native medicine.

Alxyia zeylanica. (N. O. *Apocynaceæ*). "Wal-kaduru," or "Wasā-kaduru" of the Sinhalese. A shrub found in semi-dry regions; the milky juice is poisonous.

Cerbera odallam. (*Apocynaceæ*). "Gon-kaduru," *Sinh.* A small tree, with acrid milky juice and white scented flowers; common at low elevations, chiefly near the sea, throughout India, Ceylon and Malaya. The seeds are an irritant poison, which are said to be used in India for criminal purposes.

Datura fastuosa. (*Solanaceæ*). "Attana," *Sinh.* A small shrub, with large leaves and large white or purple trumpet-shaped flowers; fruit round, with numerous prickles. The leaves and seeds are sedative and narcotic, as well as poisonous.

Datura stramonium. Thorn-apple, Trumpet Flower, "Rata-attana,' *Sinh.* A shrub with large white flowers, native of Mexico. The round green prickly fruits are a well-known poison. A drug obtained from the leaves and seed is used as an ingredient in burning powders for asthma.

Dieffenbachia. (*Aroideæ*). There are many species and varieties, all commonly known as Dumb Cane. Herbaceous, branchless, succulent plants, bearing a crown of large variegated leaves, much cultivated in gardens for ornament. The juice is highly acrid and poisonous; the slightest contact of a portion of it with the tongue will cause the latter to swell, making speech difficult or impossible for some days.

Euphorbia antiquorum. (*Euphorbiaceæ*). "Daluk," *Sinh.* A spreading, leafless tree, 15—30 ft. high, found in rocky places in the low-country: branches 3-winged, very spiny. The acrid milky juice is poisonous.

Euphorbia tortilis. (*Euphorbiaceæ*). "Sinuk," *Sinh.* A small leafless tree, found in similar places to Daluk; the milky juice is acrid and poisonous, as in fact in most plants of this genus.

Photos by H. F. Macmillan.

"DIVI-KADURU," Sinh.

[*Tabernæmontana dichotoma*]

Sometimes known as the "Forbidden Fruit," the shape of the fruit suggesting a piece having been bitten out.

"HONDALA," Sinh.

Modecca palmata

Photos by H. F. Macmillan.

"NIYANGALA," Sinh.

Gloriosa superba

MADAGASCAR ORDEAL POISON.

Cerbera Tanghin

Excaecaria Agallocha. (*Euphorbiaceæ*). "Tala-kiriya," *Sinh.* Blinding Tree. A small tree with extremely acrid milky juice. Common on the coast of Ceylon and other Eastern countries. It is one of the arrow poisons of Malaya.

Girardinia heterophylla. (*Urticaceæ*). Elephant or Nilgiri Nettle; "Gas-kahambilia," *Sinh.* A tall herb, covered with stinging poisonous hairs; found in forests of the montane zone.

Gloriosa superba. (*Liliaceæ*). "Niyangala," *Sinh.* "Ventonti," *Tam.* A well-known herbaceous slender climber, with whorled leaves whose tips end in a spiral tendril, and beautiful orange and yellow flowers. The large fleshy tubers are very poisonous, and are not infrequently eaten in mistake by the poorer classes for edible yams, often with fatal results. The tubers have recently been found to possess important medicinal qualities.

Hydnocarpus venenata. (*Bixaceæ*). "Makulu," *Sinh.* A medium-sized tree with smooth bark, common in the low-country; the fruits are used for poisoning fish. The seeds are poisonous.

Isotoma longiflora. (*Campanulaceæ.*) An annual weed with white flowers, introduced from Jamaica; has an acrid poisonous milky juice, which has been considered to be a frequent cause of death amongst ponies on the Delft Island, north of Ceylon.

Laportea crenulata. (*Urticaceæ*). Fever or Devil's Nettle; "Maussa," *Sinh.* A large shrub with large oval leaves; the whole plant is clothed with minute urticating hairs, which sting severely, the distressing effects often remaining for many days.

Lobelia nicotianaefolia. (*Campanulaceæ*). "Wild Tobacco," "Rasni," *Sinh.* A large herbaceous perennial, 4 to 10 ft. high, with large oblong leaves, found in Ceylon in open ground at 4,000 to 7,000 feet above sea level. The leaves and seeds are acrid and poisonous.

Mirabilis Jalapa. (*Nyctagineæ*). Jalap Plant; Marvel-of-Peru; Four o'clock Flower; Hendrikka, *Sinh.* An annual 1 to 2 feet high, with white or pink flowers. Roots and seeds poisonous.

Modecca palmata. (*Passifloraceæ*). "Hondala," or "Potu-hondala," *Sinh.* A small perennial climber with large shiny leaves, common in the moist low-country; the round scarlet fruit, of the size of an orange, though very attractive is strongly poisonous and has been known to cause death.

Mushroom. (*Agariceæ*). So many species of fungi, or wild mush-rooms, are poisonous that it is deemed inadvisable here to differentiate between these and those that are edible. People who are accustomed to collecting and eating the latter sometimes make mistakes with grave effects.

Nerium Oleander. (*Apocynaceæ*). Oleander; "Arali," "Araliya," or "Kanairu" of the Sinhalese and Tamils. A large shrub or small tree, with milky juice, producing large showy pink or white flowers. The roots are poisonous.

Orchrosia borbonica. (*Apocynaceæ*). "Mudu-kaduru," *Sinh.* A small tree with milky juice and greenish-white flowers, common near the sea-coast; the bright red fruit is poisonous.

Plumbago zeylanica. (*Plumbagineæ*). "Ela-nitul," *Sinh.* A perennial herb with spreading cylindrical, striated stems, 2 to 4 feet high. The long, succulent roots are acrid and pungent, and commonly used in native medicine, sometimes for illegal purposes.

Sapium indicum. (*Euphorbiaceæ*). "Kiri-makulu," *Sinh.* Small tree with smooth white bark and willow-like leaves; the acrid milky juice is very poisonous.

Solanum verbacifolium. (*Solanaceæ*). A large shrub; covered with a dense yellowish-grey tomentom; moist region up to 6,000 feet. Fruit poisonous.

Streblus asper. (*Urticaceæ*). "Geta-netul," *Sinh.*, "Pirasu," *Tam.* A shrub or small tree, with scabrous leaves, common in the low-country of Ceylon. The yellow fruit is edible, but the bark is an irritant poison.

Strychnos Nux-vomica. (*Loganiaceæ*). Nux-vomica; "Godakaduru," *Sinh.* A fairly large tree, common in the forests of the dry region; the flat button-like grey seeds are the source of the useful drug strychnine and are powerfully poisonous. They are collected from the forests and exported. The pulp in which the seeds are immersed is eaten by birds and monkeys. The bark is used as a tonic and as a remedy for skin diseases. Several species of Strychnos are used in Malaya for arrow poison.

Yucca gloriosa. (*Liliaceæ*). "Adam's Needle." A semi-woody branchless plant, 6 to 8 feet high, with long, rigid, sharply-pointed leaves; the roots are poisonous.

The foregoing do not by any means exhaust the list of plants which are entitled to be classified as poisonous; nor is it possible to give a list even approximating in completeness. It may be interesting to add the following as being among the principal plants used as arrow poisons in Malaya.

ARROW POISONS IN MALAYA.

Coscinium fenestratum. (*Menispermaceæ*). "Weni-wel," *Sinh.* A woody climber. The wood is of a bright yellow colour, and is valued as a bitter tonic by the Sinhalese.

Pangium edule. (*Bixaceæ*). A tall spreading tree, with very large ovate leaves, producing a large dark-brown fruit. The seeds have been found to contain hydrocyanic acid. Known in Malaya as Payung or Kapayung.

Derris elliptica. A leguminous climber, the seeds of which are poisonous. The plant is cultivated in Malaya for use as a fish poison, the pounded roots being the part used.

Medinilla sp. (*Melastomaceæ*). A shrub, belonging to a genus of handsome plants.

Aralidium pinnatifidum. (*Araliaceæ*). A shrub or small tree, known as Malai or Balai. Poison obtained from the tree is used in combination with that of other trees for making arrow poison.

Strychnos. (*Loganiaceæ*). Trees or strong woody climbers; strychnine is obtained from *Strychnos Nux-vomica.*

Tabernæmontana malaccensis. (*Apocynaceæ*). "Prachek." A shrub with white flowers and orange-red fruits. It is used in the preparation of arrow-poison, also in medicine.

Laportea crenulata. (*Urticaceæ*). Devil Nettle. "Jelatang." A shrub or small tree, covered with small stinging hairs which have violent urticating powers. It is used in combination with the Antiaris poison.

Excoecaria Agallocha. (*Euphorbiaceæ*). A small tree with intensely acrid milk, common throughout Ceylon, India and Malaya. *See foregoing remarks.*

Discorea doemona. (*Dioscoraceæ*). A climber belonging to the yam family. The juice of the tuber, obtained by boiling, is used along with that of the Upas tree (Antiaris).

Amorphophallus Prainii. (*Aroideæ*). "Likir," "Begung." A perennial producing a larger tuber, which throws up a single leaf at a time. The juice of the tuber is acrid and irritant. The tuber, cut in slices, boiled and washed, is eaten. Several species of this genus are cultivated as a vegetable.

H. F. MACMILLAN.

GANJA, BHANG, HASHISH.

JNO. ATTYGALLE, M. D.

Although we here use the term "ganja" generally for *Cannabis Indica* or Indian Hemp, it is only one form of it. It is met with in three forms, ganja, bhang, and charas in commerce. Ganja is the resinous and flowery shoots of the female plant before fertilisation and grows in the plains of Bombay, Bengal and the Central Provinces of India. Bhang grows in the lower hills of the Punjab and consists of mature leaves and fruity shoots and is also known as sibdi. It is from this that the intoxicating liquor hashish and the narcotic conserve or confection called madjum is prepared. Charas is a resinous powder that exudes from the leaves and flower stalks, naturally. They are called by that name because they are collected in skin bags (from *char*=skin). It is highly narcotic, and is smoked by natives mixed with tobacco. Indian hemp has a peculiarity in that the plants grown in Europe differ greatly in character from those grown in India, which are much superior in medicinal virtues. Even in India the plants that grow in different soils and districts differ from each other in character. Those grown in the plains of Bengal, Bombay, and Central India are the best. Bhang has 20 per cent of the narcotic principle and ganja only ten, whilst charas has 40 per cent. and is the most narcotic. It is to this want of uniformity in character of hemp grown in different climates, countries and even soils that Indian hemp has of late got into disfavour with Western practitioners and not because of its wanting in therapeutical properties and usefulness in itself as a medicine, or in other words for its lack of uniformity in its action. Owing to the restrictions placed of late on the cultivation of this plant by the Government of India all the best ganja is taken to Bombay, whilst only a very inferior quality of ganja grown in the West of India is taken to the drug emporium of London, and that is the *Cannabis sativa* of the British pharmacœpia. Another peculiarity of the plant is that in ganja the narcotic principle is developed only before fertilisation of the flowers. It disappears entirely after fertilisation, whereas in bhang it is developed after they are fertilised and fruits are matured, and it should also be mentioned that no resin is produced except in plants grown between an altitude of 6,000 and 8,000 feet.—Times of Ceylon.

GINSENG CULTIVATION.

I read with much interest the facts on ginseng presented by Mr. H. F. Macmillan in the April number of the Tropical Agriculturist. I am a native of the State of Wisconsin where ginseng grows wild in the forest, and is now successfully grown as an industry. I contribute the following account as likely to prove interesting reading on a little known product and to stimulate those plant explorers who are constantly adding to the world's known economic products.

J. H. Koehler of Wausau, Wisconsin, was for a number of years known as the "ginseng crank," but now he is respectfully referred to as the "ginseng king." As a boy he dug up some wild ginseng roots in the Wisconsin forest and never forgot the impressive way his father said to him: "The Chinese will pay any money for this root dried, but it is so scattered that it is difficult to collect in large quantities." Young Koehler grew up and became owner of a modest pine lumber saw mill. One day a newspaper article reporting that ginseng was in great demand and bringing a high price because of its increasing scarcity, again awoke all the dreams of his boyhood and he began to experiment in planting it. His small plot of land cost him a good deal, for in three years he spent 3,700 dollars in experiments. He thereby learnt something of the nature of the plant and what it needs to thrive, and went on to spend 14,194 more! The whole enterprise only occupied three-fourths of an acre, but this had to be roofed with spaced slats to approximate forest-shade conditions. Koehler gradually learned what leaf mould soil conditions were required, and then had to wait five years while the roots grew. He was constantly ridiculed over this venture and everyone predicted failure. His lumber business suffered, not through his neglect but because the banks and others considered him "ginseng crazy."

Without going into every detail, the result was that at the end of eight years he had sold ginseng from this three-quarter acre plot to the value of 58,994 dollars, which left him a profit of 41,100 dollars, the average per cent. of net profits being 137 per cent. per annum. The business paid back the entire capital, together with 6 per cent. interest within six years from the time the first dollar was invested, and after that there was an average net profit of 360 per cent. per annum, calculated on the original investment.

During the period under review the price of ginseng rose to 12 dollars a pound and speculators sold ginseng seeds as high as five cents each, and when the supply was exhausted they sold wild turnip seeds instead! Efforts were also made by applying fertilizers and artificial heat to stimulate rapid growth, but the result was that the roots became diseased and decayed. The ranks of ginseng growers were thinned out and hundreds of incipient projects were nipped in the bud. Then everyone took up the cry "cultivated ginseng is doomed," and anti-ginseng articles were popular in the press, and even the U.S. Department of Agriculture issued a warning, cautioning the public not to put too much faith in ginseng. In the midst of this chaos, Koehler continued growing ginseng, spreading money to develop his miniature plantation of less than an acre, which only went to confirm the general opinion that he was stark mad. Several years later, when by the

legitimate sale of well-prepared ginseng he cleared up a net profit of 41,100 dollars, he came to be known as the "ginseng king," a title to which he has been adding dignity and lustre ever since. All this is not ancient history, for KOEHLER started in 1901. The first few years were spent groping his way in the dark, and his first large harvest came only at the end of eight years, after having pioneered the work of putting what was known as a "freak" crop on a solid business footing. He early recognised that the only way to secure high grade roots that brought the top price lay along the line of scientific breeding and development. While all the ginseng looked alike to the American, the Chinese recognised differences. By experimenting KOEHLER found that "debudded" plants made excellent root growth, and he further discovered that these did not shrink as much as the others in drying, and also that he secured the highest price for this root.

KOEHLER's extraordinary success in making this freak crop what it is does not prove that every enthusiast can take up some new product and necessarily succeed. The product may have possibilities, but the person may be temperamentally unfitted for the task, or lack patience and business acumen; or he may be unable to command sufficient capital to make the venture possible; or again the venture may be unsound.

KOEHLER succeeded with ginseng while hundreds failed. He had the qualities that compelled success, among which were the courage to stand by his convictions and see the thing through, and also had money to assist him and a strong belief that the project was feasible if the natural conditions under which the crop grew were approximated.

As the thermometer at times registers as low as 40° F. below zero in Wisconsin, it is hardly to be expected that ginseng will thrive in the tropics.

A. W. PRAUTCH,
Manila, Philippine Islands.

RICE IN BRITISH GUIANA.

PROF. HARRISON.

The area under rice in 1898 was 6,000, acres; in 1914 it was 45,000 acres. The increase represents about 32,000 tons of cleaned rice per annum worth about £450,000. The enormous extent of land suitable for this cultivation should enable the Colony to become the granary of the West Indies.

The common variety cultivated is known as "Creole," said to be of excellent quality, the choicest strain of which is the "Berbice."

Cultivation is still carried on by hand and cattle labour, but labour-saving methods are being gradually introduced. A great many rice mills exist. It has been found that locally grown paddy gives from 60 to 65 per cent. of its weight of clean rice. Last year 240 tons of rice meal were exported. The average yield of paddy per acre is 22·2 cwt.—BULL. OF THE IMPERIAL INSTITUTE.

PAPER PULP.

INDIA AS A SOURCE OF PAPER-MAKING MATERIAL.

CHAS. PHILLIPS.

Among the various fields of investigation to which chemists and cellulose experts have devoted attention, with satisfactory results, are the vast bamboo-producing areas of India and Burma, where, it has been estimated, there are millions of acres which are either bamboo forests or are perfectly adapted for the cultivation of bamboo. In this connection, valuable service has been rendered by the Forest Research Institute, Dehra Dun, with whose work Mr. W. Raitt and Mr. R. S. Pearson are so honourably associated. So successfully has bamboo passed the experimental stages, that it may already be said to have come within the realm of paper-making materials, and it is not at all improbable that in the near future it will have taken its place as one of the principal fibres from which paper can be produced, especially in the Far East. Up to the present, however, the only two mills for the pulping of bamboo of which I have recollection are one belonging to the Mitsu Bishi Company (Japan) in Formosa, and the other to a Tonkin corporation near Haiphong, in Indo-China.

The researches of Mr. Sindall, Mr. Richmond, Mr. Pearson, and Mr. Raitt, followed by factory tests in this country and in India, have demonstrated the suitability of bamboo cellulose for the manufacture of paper, particularly printing and litho grade, "provided its isolation has been successfully accomplished," and showed a general agreement that reduction by soda was the only practical method applicable. The commercial exploitation of bamboo was a matter of some initial difficulty owing to the fact that there were several hundreds of species growing over a wide range and variety of latitude, elevation, climate, and soil. These, therefore, became the subject of an exhaustive inquiry by Mr. Pearson, the official Forest Economist to the Government of India, who arrived at what proved to be the well-founded conclusion that only five species of bamboo existed in commercial quantities and under economically exploitable conditions. In the course of a paper on the subject of "Bamboo Cellulose," presented two or three years ago at the International Congress of Applied Chemistry, Mr. W. Raitt, of the Imperial Forest Research Institute, Dehra Dun, India, stated that, "though few in number, these species are so dominant in their own area that they probably represent 80 per cent. of the whole growing stand of bamboo in the country." It may, therefore, be considered that the adaptability of bamboo to paper-making purposes becomes of first-class importance, especially to our Indian Empire, where paper-mills have been not altogether remunerative, owing to the fact that much of their raw material has hitherto been brought from distant lands. Experts have already arrived at the opinion that before long bamboo will become a staple article for the production of paper in India, and

RAITT calculates that it is admirably suited for probably 50 per cent. of the entire trade. "For the better classes of writing and ledger paper," he states, "bamboo pulp is not so useful, as it is lacking in the strength and firmness which is essential for these grades."

My friend, MR. SAMUEL MILNE, of Messrs. Bertrams, Ltd., who has made a long and deep study of the question of the treatment of bamboo which, he says, depends more upon the plant than on the chemical used, emphatically asserts that it is quite safe to say that no fibre available in quantity at the present moment can be superior to bamboo. He maintains that it is suitable for the highest qualities of paper, and when properly treated, can also be converted into excellent kraft paper. MR. MILNE was good enough to furnish me with several samples of bamboo pulp, and referring to one of an easy bleaching pulp from Tonkin, he states that it is of the thin walled type and can be treated without difficulty to produce pulp of the highest quality. As a matter of fact, he is of the strong opinion that, properly handled, bamboo can be used for practically anything for which cellulose is suitable. MR. MILNE, I believe, has for a long period been developing an improved method of treatment of bamboo by means of the ordinary caustic soda process with modifications to suit the particular necessities of the material, and to ensure greater economy of working than is at present obtained with the best plants working esparto, and is convinced that suitable bamboo can be converted into an easy bleaching pulp at practically the same cost as esparto. So certain is he of his ground that he is prepared to guarantee results.

In drawing your attention to some slides illustrating bamboo, with which my friend, MR. CHRISTIE, has supplied me, it may be mentioned that the elements of the stem which enter into the composition of the pulp are mainly derived from: (1) The broad zone of fibres lying under the epidermis; and (2) from the fibres forming the sheath of the fibro-vascular bundles running through the whole stem. Besides these actual fibres the pulp contains parts of the large and small vessels with their characteristic markings; parenchymatous cells form the ground tissues and epidermal cells with serrated edges.

In the section of the whole stem the fibro-vascular bundles with their large vessels of wide cavity are seen disposed in fairly regular concentric rings throughout the ground tissue or parenchyma. The enlarged section of a portion of the stem shows the hypodermal layers of fibres and fibro-vascular bundles more clearly.

The longitudinal sections of node and internode are chiefly interesting from the structural point of view and call for no particular remarks.

For nearly a generation the leading Indian paper-making fibre has been the baib or sabai grass *(Ischæmum angustifolium)*, the similarity of which in appearance and quality to esparto lead English paper-makers in India to utilise it for paper-manufacturing purposes in that country. Again, using MR. RAITT as my authority, "when carefully collected, free from weeds and foreign matter, it is one of the best and cleanest materials known for the production of the finest printing and medium quality writing-papers." Owing to the fact that no portions of the leaf or flower culm differ materially in composition from other portions, and that even the nodes do not suffer any serious resistance to the action of the digestion liquors, baib is easily reduced

to a clean and regular pulp, and the paper made from it is scarcely distinguishable from esparto. Latterly, however, there appears to have been experienced a serious deterioration in quality and falling-off in quantity collected per acre or mile. MR. RAITT, indeed, states that baib is, in short, suffering from the effects of over-cropping, and he suggests that, in the case of certain other grasses whose crops represent a very much larger weight per acre, factories should obtain control of areas considerably in excess of their annual requirements, so as to permit of portions being occasionally allowed to rest uncropped for one or two years.

I had a very interesting conversation with a Japanese paper-maker last year, who informed me he had completed arrangements for operating his company's mill on bamboo fibre.

This brings me to speak of the Savannah grasses of Northern and Central India, which have been the object of considerable study by the experts of the Forest Research Institute at Dehra Dun, with a view to determining their cellulose or paper-making value. Hitherto paper-making experience of grasses on a practical and commercial scale has been confined to the cereal straws, esparto, and the baib grasses of India, all of which are easily treated as they are not strongly lignified, and their nodes or knots are small and easily dealt with. MR. RAITT, to whose interesting report upon the subject I am largely indebted, states that the Savannah grasses are of a very different type, being much larger and coarser, more strongly lignified, and having hard and large nodes. It is, therefore, encouraging to learn, on his authority, that the need for a strong, long-fibred pulp having some of the qualities which at present can only be obtained by the use of linen and cotton rag may probably be supplied by several of the coarse Savannah grasses common to much of the waste and thinly-forested areas of India. In the course of his report, MR. RAITT entered into an exhaustive examination of these grasses from the physical, analytical, microscopical, and other points of view, with which it would be superfluous for me to deal, but the results of his experiments in digestion with caustic soda are interesting, as showing that of ten species of grasses only two—*Imperata arundinacea* and *Eragrostis cynosuroides*—proved weak and short in fibre, difficult to bleach, and of little value as second class pulps to be used in mixture with stronger ones. The remaining eight species, all of which produced good strong pulps, were—*Saccharum spontaneum*, *S. arundinaceum*, *S. munja*, *S. narenga*, *Anthistiria gigantea* sub. sp. *arundinaceum*, *Anthistiria* sub. sp. *Villosa*, *Arundo donax*, and *Phragmites karka*. Eight other grasses were similarly experimented with, and of these the following were found to yield good clean pulps suitable for mixing with either of the eight I have already mentioned—*Saccharum fuscum*, *Andropogon intermedius*, *A. squarrosus*, *A. nardus* and *Erianthus ravennae*.

Each of the ten grasses mentioned produced fibres of the long slender type with tapering points, ranging from 4·70 to ·50 mm. in length, the outstanding feature being the marked superiority of *Anthistiria*, as to which PROF. HANAUSEK, of Vienna, a well-known fibre microscopist, reported as follows :—"With regard to length, it appears to surpass all other straw or grass celluloses. It must yield an excellent pulp. combining fineness, equality and strength." MR. RAITT adds that several of the *Saccharum* group approach it,

as also does *Phragmites karka*, while all are regarded as first-class, possessing the features desirable for the manufacture of high grade writing-papers, or for admixture with second-class pulps like bamboo, in order to gain firmness and strength. The eight grasses which have thus received the benediction of experts, and which are calculated to be capable of adding several million tons annually to the paper and pulp-making resources of India, are found over a wide area extending from Sindh to Burma, with the result that there must be wide divergencies of manufacturing facilities, labour, freight costs, etc. Mr. Raitt aptly summarises the position when he states: "As a general rule grass districts connote inland, upland, and comparatively dry country, with long railway leads to seaports, coalfields, and papermills, and an absence of the cheap water transport frequently found associated with bamboo. An exception to this will probably be found in the extensive grass-covered Savannahs on the banks of the Brahmaputra and its tributaries. The cost of cutting and collecting will also be more than for bamboo, as the greater size and weight of the individual culms of this material permits a larger quantity of it to be collected per coolie per day, so that generally, and especially in the absence of water transport, the cost of grass pulp must exceed that of bamboo pulp. This, however, will be compensated for by its better market value."

Mr. Raitt provisionally estimates that the cost per ton of unbleached pulp at the factory would work out at between 100 and 119 rupees, and goes on to say: "Unbleached baib pulp cannot be produced in our local papermills with their long railway lead on raw material for less than 155 rupees, and in some instances 170 rupees, per ton. The former figure may, therefore, be regarded as their minimum market value, and it is less than the delivered cost of the European chemical wood pulp now being imported to make up the shortage of baib. There is, therefore, a margin on the above estimated costs of from 35 to 55 rupees available for manufacturer's profit and payment of freight to consumer.

Another potential paper-making material which has been described as a native of India, being distributed from the Himalayas to Ceylon and Malacca, is *Hedychium coronarium*, to which Mr. Clayton Beadle and Dr. Stevens drew the attention of the Royal Society of Arts a little more than two years ago. Brazil, however, appears to be the fibre's chief home so far as it may be said to come within the scope of the paper-making industry, and it was in that country, at Morretes, Parana, that rough paper was first produced from it. Subsequent to the Society of Arts communication, Messrs. Beadle and Stevens, in my own journal, The Paper Maker, and in other ways have outlined the result of further investigations with regard to *Hedychium*, and it is interesting to note that their tests of some dried-down specimens of the plant from Calcutta were satisfactory in result. They were boiled with 10 per cent. (of 77 per cent.) caustic soda for four hours at two and a half atmospheres, washed free of liquor, and lightly brushed for three hours in a hollander, then made into paper without any sizing material. The conclusion is arrived at that from 80 to 90 per cent. yield of paper on the raw dry fibre weight can be obtained. The paper manufactured from the Calcutta sample is described as "good," although not like the Brazilian, but the yield is said to have been

much lower. Unfortunately, however, the upshot of Messrs. Beadle and Stevens' inquiries, stated in their own language, is "that there is no real promise of success outside the State of Parana, Brazil, in which country it grows in wild abundance and profusion." Quite recently the experts I have mentioned have tested a sample of the stems of *Hedychium flavescens* forwarded to Kew by the Director of Agriculture, Ceylon, in order that its paper-making qualities might be compared with that of *Hedychium coronarium*, and I gather that the results of their investigation show that the stems of *Hedychium flavescens* furnish a paper of similar character to that afforded by the stems of *Hedychium coronarium* but in somewhat lower yield.

Another grass to which the attention of the Research Institute, Dehra Dun, India, has been drawn is moya grass (*Pennisetum alopecuros*), which, reports state, yields 39 per cent. of easy bleaching pulp similar in quality to that obtained from baib grass. It is said to grow over large areas in the hills of the Central Provinces, and to be capable of collection at a low cost. It is, indeed, considered that in the neighbourhood of the Pench Valley Coalfield —says a Bulletin of the Imperial Institute—15,000 to 20,000 tons could be collected annually at a suitably situated factory site, at a cost not exceeding 15 rupees (£1) per ton.

Quite a number of other plants, chiefly from India, have also been examined, tested, and reported upon during the last few years, among them being *Iris ensata* var. *Oxypetala*, abundant in Kashmir; *Musa textilis*; and *Spatholobus roxburghii*, collected in Bengal. The results, however, were not of a very satisfactory character. The leaves of the *Iris ensata* were found to contain 42·3 per cent. of cellulose calculated on the dry material, which is a much lower percentage than is usually present in esparto grass, and it is considered improbable that they could be used as a source of fibre, and that they could compete with such cheap material as esparto grass or wood pulp. *Musa* sheaths contained a much lower percentage of cellulose and a higher percentage of ash than esparto grass. This fibre might be utilised in the manufacture of Manilla papers, but could not compete with Manilla rope. In the tests of *Spatholobus* negative results were obtained.

There is one other great source of fibre which India might profitably exploit, viz., the cotton seed cotton obtained from the down of the cotton seed by a process of dry mechanical separation. Beadle and Stevens, in recent years, have very carefully investigated the question of the paper-making possibilities of this fibre, and from hulls shipped from India, as well as from the United States, paper has been made. The Indian fibre, however, is of shorter staple than that from the States of Egypt, and, moreover, the notoriously dirty condition of Indian seed prevents the mechanical separation of the cotton being as remunerative as that from the Brazilian or the American seed, the product from which is now used in large quantities in place of rags for the highest qualities of paper, thanks to the mechanical improvements initiated by Minck, and subsequently brought to a state of perfection by E. de Segundo.—The Paper Maker.

CO-OPERATION.

PROGRESS OF CO-OPERATION IN CEYLON.

R. N. LYNE.

This report by Mr. N. Wickremaratne, Secretary of the Board of Control, is a record of the Co-operative Credit movement in Ceylon after two years' experience. There are, as will be seen, some failures to record, as might have been expected, but on the whole it is a chronicle of satisfactory progress. The number of societies has increased by 19, from 35 to 54; the total membership by 2,030, that is from 1,820 to 3,850; and the paid-up capital by Rs. 10,630; it now stands at Rs. 18,832, as against Rs. 8,202 n 1913-14.

On April 28, 1914, a general meeting of Co-operative Credit Societies was held in Kandy. It was presided over by His Excellency the Governor and constituted an important milestone, because out of it grew the appointment by His Excellency of a Committee to report on the advisability of establishing a Local Loans Fund, and on the scope of such fund, if established. Their report was published as Sessional Paper XVII. of 1914, a document that has not attracted the public attention it deserves. The Committee, in view of the possibilities of further developing the resources of the country on organised lines, recommended the establishment of such a fund for the purpose of making loans to public bodies, Co-operative Credit Societies, Co-operative Industrial Societies, and Government officers for the purpose of building houses for their own residence. With such a scope for its operation a Local Loans Fund, when once its use was understood, would become the base upon which the industrial and financial welfare of the people would rest, and a firm, enduring base it would be.

An event of some importance during the year under review was Sir Horace Plunkett's speech at the London Congress of Tropical Agriculture in June, 1914. Sir Horace is one of the greatest living authorities on the Co-operative Credit movement. The final proposition, he said, if you want to solve the modern problem of rural life, is to look upon agriculture as an industry, as a business, and as a life. In dealing with the business side of farming—hitherto neglected—the first thing is to emancipate small producers from the toils of powerful middle interests, which can only be done by combination in the form of co-operation, the only kind of combination suitable to their conditions. You must begin with better business, and better business is co-operation.

In those parts of Ceylon where the principles underlying co-operation have been intelligently studied and their importance understood by the leaders of the people upon whose influence success must depend, the movement has gathered momentum sufficient to ensure steady progress in the future. The

common people have no opportunity of studying for themselves; literature on the subject is beyond their reach. A great responsibility therefore rests upon those in a position to educate and lead the people, but neglect to do so. For it should be remembered that co-operation as a means of bettering the conditions of the rural population of a country cannot now be challenged. It is too world-wide for that. The only barrier that stands between the people of Ceylon and this emancipating measure is ignorance of its true nature. The efforts of the educated classes are required to break down this barrier in those districts where it still exists.

N. WICKREMARATNE.

Conference.—The Conference of Co-operative Credit Societies has been useful in arousing public interest and popularizing the movement. One now hears more of the Co-operative Credit movement than hitherto. A certain society was established as a direct result of the Conference, the organiser although an opposer of the movement, becoming a convert at the Conference.

Our Helpers.—The Low-country Products Association, the Total Abstinence Central Union, and the Ceylon Social Service League have given their attention to this movement and passed resolutions in sympathy with it.

The Secretary of the Total Abstinence Central Union reports that the subject of Co-operative Societies was discussed at several of their district quarterly conferences, and as a result several societies have started work. We look forward to see these societies brought under the Ordinance.

The Ceylon Social Service League has adopted as part of its programme the promoting of Co-operative Credit Societies. This is an encouraging step.

Growing of Food Crops.—The Registrar isssued a circular just after the war broke out to all the societies then in existence, requesting them to encourage the raising of quick-growing food-crops in village gardens, and conserving of sufficient seed paddy for future use: the societies responded well. Some distributed among members vegetable seeds received from the Ceylon Agricultural Society through its Secretary, MR. DRIEBERG.

Paddy Manure.—The Colombo Commercial Company is very generously prepared to supply manure, to be paid for in six months' time, to registered and approved societies, at a discount of 5 per cent.

The GOVIKAM SANGARAWA, the Sinhalese magazine of the Ceylon Agricultural Society, edited by MR. C. DRIEBERG, B.A., F.H.A.S., and the press in general continue to render assistance to popularize the movement. The Sinhalese Press published the specimen bye-laws sent to them, with long leading articles commending the co-operative movement to their readers.—

REPORT ON CO-OPERATIVE CREDIT SOCIETIES, CEYLON.

GENERAL.

CEYLON AGRICULTURAL SOCIETY.

ANNUAL MEETING, 1915.

At the Council Chamber, Colombo, 31st August.

The Annual Meeting of the Ceylon Agricultural Society for the year 1914-1915 was held at the Council Chamber at 12 noon on Tuesday the 31st August, 1915, the Organising Vice-President presiding, in the absence of the HON'BLE THE COLONIAL SECRETARY who was kept away by illness.

There were present :—MR. R. N. LYNE (in the chair), HON'BLE MR. A. KANAGASABAI, REV. FATHER PAUL COOREMAN, DR. H. M. FERNANDO, DUNUWILLE DISAWA, MUDALIYARS WALTER DIAS BANDARANAYAKE and TUDOR RAJAPAKSE, MESSRS. E. B. DENHAM, W. A. DE SILVA, L. W. A. DE SOYSA, K. BANDARA-BEDDEWELA, H. L. DE MEL, N. J. MARTIN, A. W. BEVEN, J. M. HENRY, D. S. CORLETT, A. BRUCE, G. BRYCE, L. E. CAMPBELL, JAMES PEIRIS, B. F. SCHERFFIUS, J. C. DRIEBERG, H. L. VAN BUUREN, F. L. DANIEL, J. C. DE SILVA, A. W. WINTER, C. B. BRODIE, N. WICKREMARATNE, and C. DRIEBERG (Secretary).

Before the business for the day was begun the following resolutions were passed :—

(1) "That this Society has learnt with deep regret the news of the death of the son of the PRESIDENT, and of CAPTAIN RALPH CHALMERS being wounded and missing, and records its sincere sympathy with HIS EXCELLENCY and LADY CHALMERS."

(2) "That this meeting of the Ceylon Agricultural Society desires to express its sympathy with MRS. LOCK on the death of DR. LOCK, late Director of the Royal Botanic Gardens." Proposed by MR. E. B. DENHAM, seconded by DUNUWILLE DISAWA and passed.

The Minutes of the last Annual Meeting held on the 11th August, 1914, were read and confirmed.

THE SECRETARY gave a summary of his Report for the year. After remarks by the HON'BLE MR. KANAGASABAI, DUNUWILLE DISAWA, DR. FERNANDO and MR. A. W. BEVEN, the report was adopted.

The statement of accounts for the year 1914 was accepted.

THE CHAIRMAN expressed his appreciation of the work done by the Secretary not only for the Society but also for the Department of Agriculture.

Samples of cigarettes made from Egyptian tobacco raised at Jaffna by MR. SCHERFFIUS were submitted for inspection.

THE CHAIRMAN gave details of his scheme for a School of Agriculture at Peradeniya.

MR. MACMILLAN read his paper on "The Making of Loans in the Tropics," which evoked much interest.

MR. WICKREMARATNE read an abstract of his paper on Sugar-cane Cultivation. MR. BEVEN, MR. WINTER and the CHAIRMAN offered remarks.

THE CHAIRMAN announced that HIS EXCELLENCY the President had appointed the Board for the ensuing year, and that the names would be published in the usual course.

Lacquered articles made from lac produced by the insects introduced from India were exhibited

The meeting terminated with votes of thanks to the writers of the papers.

C. DRIEBERG,
Secretary, C.A.S.

Peradeniya.

CASTOR SEED CULTIVATION IN THE WEST INDIES.

An enquiry concerning the cultivation of the castor plant, recently received at this office, includes a statement to the effect that an acre under this crop will yield £14 net. The facts relating to castor cultivation show this estimate to be high, and it may be of interest to consider them.

The time which the castor crop takes to come into bearing varies with the variety and the climatic conditions under which it is grown ; the fruits may be gathered in four months, but it may be seven months or even longer. With 1,210 plants per acre (planted 6 feet by 6 feet,) the yield may be expected to be, under ordinary circumstances, about 1,000 lb. Assuming that two crops could be produced annually, the yield would be approximately 2,000 lb. The price of castor seed at Liverpool in May, 1912, was £12 per ton (it apparently varies from £9 to £13), so that the gross revenue from an acre each year would be £10 15*s*. Subtracting the cost of cultivation and transportation, which would amount to at least £4, we arrive at an estimate of £6 15*s*., which is less than half that which has been quoted above. Even £6 15*s*. is probably too high since, as already intimated, it is not possible to rely upon two crops each year (because of climatic conditions), and certainly unwise to expect the maintenance of the English market price at a normal level like £12 per ton.

The castor plant makes an exhausting crop and can only be grown commercially on good soil. The oil is usually expressed abroad, but if done locally the residual cake, being unsuitable as a food stuff, makes a useful manure. The most likely way of growing castor seed profitably in the West Indies is as a catch crop on well manured land, or as is done in India, growing it around cotton or sugar-cane fields or with potatoes, cereals, or a leguminous crop.

It may be added that experiments with castor oil have been conducted at several of the Botanic Stations in the West Indies, especially at Antigua during 1908-10. Here two 1/10 acre plots were planted 5 feet × 4 feet on February 17. Each plot contained two varieties, that is, 1/20 acre was planted in each variety. The seeds were harvested on November 1. Hence the crop was in the ground nine and a half months.

The yields were as follows :—

Ricinus	No.	3,173,	65 lb.	shelled	seed	or	1,300 lb.	per acre
,,	,,	3,172,	61 ,,	,,	,,	,,	1,220 ,,	,,
,,	,,	3,176,	48 ,,	,,	,,	,,	960 ,,	,,
,,	*Zanzibariensis*,		42 ,,	,,	,,	,,	840 ,,	,,

The crop is not grown in Antigua or any one of the Leeward Islands except to a limited extent as a green dressing, and an extension under ordinary circumstances is not to be expected.—Agricultural News.

THE TRANSPIRING POWER OF PLANTS.

A. L. BAKKE

The studies upon *Verbascum*, as presented in this paper, show that the transpiring power of younger and older leaves is not to be considered the same, a proposition probably generally accepted. They suggest also that, apart from age, the position of a leaf upon the stem and the variations in structure related to correlations, may influence its transpiring power.

Various plants growing under more and under less arid conditions of the soil and air give differences in transpiring power which suggest that the same species may possess quite different indices, when grown under moist conditions, from those exhibited by individuals grown under dry conditions. Opportunity was not offered for a definite study of this relation, but it appears that the magnitude of the foliar transpiring power is probably a physiological character that will be found to vary for each species, within somewhat distant limits, just as do the cruder morphological characters employed by plant taxonomists, such as leaf size, shape, hairiness, etc.

The relation between diurnal and nocturnal transpiring power can be studied advantageously by means of the method of standardized hygrometric paper, in the same way as this method is available for the study of the daily march already mentioned.

The ecological classification is a classification according to water-need, as far as this depends upon foliar transpiring power, and the agricultural problem of determining the relative drought resistance of different crops or different varieties should be approachable by means of such studies as are here reported. The tests recorded for *Medicago* and *Sorghum* point promisingly in this direction. The full diurnal march of foliar transpiring power should probably be employed, however, rather than merely a few day and night determinations. Of course a comparatively large number of individual tests will be requisite, more of these with some plant forms than with others, but the method here employed appears to be by far the most satisfactory yet suggested.

Studies on the transpiring power of potted *Phaseolus* plants before and after wilting agree in general with the conclusions of F. Drawin, that resistance to transpiration increases at wilting, and with those of Livingston and Brown, that incipient drying may produce such an increased resistance before wilting occurs. No attempt is here made to deal with the question regarding the causal conditions determining the fall, as wilting occurs, in the values of the indices here used. It is suggested, however, that foliar transpiring power may be a characteristic of plants, the magnitude of which may prove valuable in predicting the need of irrigation long before the occurrence of any wilting.—Bull. No. 55, Iowa State College, Ames.

PREVENTIVE ENTOMOLOGY.

An editorial in the last (April) number of the Journal of Economic Entomology is suggestive of a line of entomological work which has been but little developed, but which has great possibilities, especially in a state like California, where the insect problem is vital. In medicine the old saying "an ounce of prevention is worth a pound of cure," has been found to be especially true, and we are now witnessing in that science a marked growth in the prophylactic branch as opposed to the therapeutic. In the future, undoubtedly, there will be a great deal of attention paid to what might be termed "preventive entomology." It is true, as the editorial says, that the forecasting on insect outbreaks has its perils, but there are some instances where the chances of making a wrong prediction are so small as to be almost negligible. Instances of this kind occur, of course, in connection with those pests, such as most scale insects which have a comparatively simple life history and whose ecological relations are not exceedingly complex. A good example of this kind in California is the European Fruit Lecanium, *Lecanium corni*. Every spring, in May or June, numerous complaints are received from growers whose orchards are severely infested with

this scale. By the time the complaints are received it is too late to adopt control measures. The damage is already done. Yet the insect is not difficult to control, and had the grower been informed by some one competent to make a careful examination of his orchard during the latter part of winter when the scale was small, that the prospects were good for a heavy infestation, a serious monetary loss could have been avoided. California, with her large corps of horticultural commissioners and inspectors in every part of the State, is well equipped for this type of work, and as a matter of fact it is already carried on to a large extent, but generally at the suggestion of the individual orchardist. Would it not be desirable for the county commissioner, through his inspectors, to examine every prune and apricot orchard in his county during winter, making careful counts of the brown apricot scale, from which examination he could give accurate information as to which orchard would be badly infested and which would not? With the police power which is granted the county commissioners this policy would have a salubrious effect upon the quality and quantity of the fruit crop of the county as a whole. There are many other pests which might be handled in this way to the great advantage of the county and especially of those growers who are not sufficiently well informed on entomological questions to make the forecast themselves. The peach worm, *Anarsia lineatella*, is an example; the mites or red spiders, another. It might even be possible for a careful observer to predict, by ascertaining the number of eggs on the twigs during winter, whether or not the green apple aphis would be abundant during the following season. It is a fact that only a small percentage of these eggs survive the winter, and it would of course be necessary to take this winter mortality into account in making an estimate. Perhaps the mortality occurs sufficiently early in the winter that the examination could be postponed until this mortality had occurred, and still be in time to adopt remedial measures before the leaves come out in the spring. This "advance information," as Doctor Felt calls it, would also save a considerable sum of money for that rapidly decreasing class of growers who spray just "because the trees seem to need it," and for that reason spray sometimes when it is not necessary.

Out of this thought the question arises: When, *in relation to the abundance of the pest*, is the most economical time to adopt control measures in order to prevent injury? In practically all cases where scale insects are concerned, spraying is delayed until the pest is abundant on the trees. The percentage of kill, when taken alone, has no bearing whatever upon the effectiveness of the treatment. The factor of importance is the *number* of living scales which are left after treatment, not the *percentage*. A kill of 50 per cent. would be equally as effective as a kill of 95 per cent., if in the latter case the scale were ten times as abundant as in the former. There would be left to re-infest the tree for the next year an equal number of scales in either case. It might be much easier to get a kill of 50 per cent. in the one case than 95 per cent. in the other. As a concrete example, it might be more economical to treat for the brown apricot scale when it is comparatively scarce in an orchard and thus prevent it from ever becoming a pest, than to wait until it is abundant before attempting control measures. As a general rule, when a scale becomes sufficiently abundant to cause the grower to consider remedial measures, it has already done much damage. This damage might be avoided by the action suggested above. There is, some place, a happy medium between spraying only when the scale has become abundant and spraying every year regardless. Spraying at that time could very properly be termed "preventive entomology," and its usefulness ought not to be difficult to demonstrate.

One other phase of economic entomology might come under the head of "preventive entomology," and that is the use of parasitic and

predaceous insects. Few entomologists nowadays will maintain that introduction of the enemies of an insect pest will entirely control it, even under the most favourable circumstances. The ecological relations of insects are such that perfect control by means of parasites is practically impossible. As Marchal says, the fluctuation in numbers of host and parasites is the *sine qua non* of the existence of the species. But the introduction of parasites and predators may have a very profound influence upon the abundance of an insect pest by checking to a certain extent its increase. The more enemies an insect pest has, the less frequently will it reach the stage of abundance where artificial means of control must be adopted, and it is along this line, which might well be termed preventive entomology, that the work of the State Insectary is being prosecuted at the present time.—H. S. S. in the Monthly Bulletin of State Commission of Horticulture.

LIGHTNING IN THE TROPICS.

T. PETCH.

In a recent publication, entitled Die Blitzgefahrdung der verschiedenen Baumarten, Dr. Ernst Stahl has collected and discussed all that is known of the effect of lightning on trees, and has described new experiments, which afford further explanation of the natural phenomena recorded. It is remarkable that practically the whole of the information available refers to temperate climates ; indeed, that which relates to the tropics is so brief that it may be quoted in full :—

According to Hann (Handbuch der Klimatologie, Bd. II., page 20), the lightning which accompanies the violent thunderstorms of the tropics has the most remarkable peculiarity that it very seldom sets things on fire or proves fatal. Moreover, injury to trees is relatively much less frequent than in temperate climates. During a stay of four months at Buitenzorg, which happened to coincide with the rainy season, when severe thunderstorms occurred almost every day, I only remember hearing of two cases, the one a palm, and the other a large *Ficus elastica*.

Seeman (Journal of Botany, V., page 378) has noted that "no observations seem to be on record of coconut palms being injured by lightning, though, as Tennent in his well-known work on Ceylon states they are known to be excellent lightning conductors."

A short communication from Herr Z. Kamerling records that injury by lightning occurs from time to time in Java and Sumatra, for example, in the case of the coconut palms, but somewhat rarely. He is of opinion that the numerous trees bring about a slow equalization between the earth and the clouds, and that discharges, in general, take place from one cloud to another, but only rarely between the clouds and the earth.

Dr. C. Bernard states that at Buitenzorg *Albizzia* and *Ficus* are often struck by lightning, and coconut palms are killed. But he notes that *Oreodoxa* and other palms, which often stand in isolated positions, are not struck, and suggests that the vertical shoot formed by the young unfolded leaves acts as a lightning conductor. None of the palms which form the *Oreodoxa* and *Areca* avenues in the Botanic Gardens have up to the present been struck by lightning.

Pechuel-Loesche (Uber Blitze und Blitzschlage, page 93) has recorded that in spite of careful search he was not able to find trees injured by lightning in the regions of the Loango Coast, though at various times he had observed the lightning fall on isolated giant trees so near at hand that he heard only a short sharp, clap of thunder.

The natives display no fear of lightning ; they take shelter under trees without hesitation if they are caught in the open by thunderstorms. The view that very few flashes reach the ground might, therefore, appear to be justified. But I cannot agree with that opinion ; and I would venture the explanation that the enormous volume of rain water which saturates the porous soil, or, while running off, constitutes a mantle over the thick thatch of the huts probably, being a good conductor, affords protection to the latter at least. PECHUEL-LOESCHE's observations can no doubt be explained by the fact that the tropical rainstorms soon wet the bark, which is generally smooth, and so furnish a practical protection.

In dealing with the Mediterranean region, DR. STAHL cites DR. TRABUT as stating that in Algeria thunderstorms and injury by lightning are rare, but in the oases the date palm is frequently struck. In the case of one palm which had been struck a short time previously, DR. TRABUT found the crown dead and in course of decay, and a long split in the stem. The author accounts for this excessive injury to the date palm by the facts that it is taller than the surrounding vegetation, that in consequence of the structure of its crown and stem, it is not readily wetted by the rain, and, not least, by its position in a damp situation in a dry region.

It will be noted, no doubt with some astonishment by residents in the tropics, that the records which DR. STAHL has been able to discover of injury by lightning to tropical trees in general and palms in particular are remarkably few. This is no doubt to be explained in great measure by the fact that the daily common-places of tropical life pass unrecorded, though it would appear to be correct that, comparatively speaking, the frequent thunderstorms of the tropics cause less injury than those of temperate climates.

This latter view is fairly widely held. VON DANCKELMANN, writing in NATURE, December 11, 1884 (Vol. 31, page 127), stated :—

It is a remarkable fact that in all the publications relating to Africa we so seldom come across accounts of injuries caused by lightning. Some travellers—those of the German Loango Expedition of 1873—76 for example —even distinctly report that, notwithstanding the extreme frequency of lightning in Africa, cases of damage inflicted by it are almost unheard of. During my own stay on the Congo, though I was eagerly on the lookout for instances of this kind, I did not succeed in authenticating a single case of injury due to the electric fluid. There was, indeed, a vague rumour among the natives of a man in some village having been struck dead and of "tshimbek" burnt down by lightning, but I could find no eye-witnesses to the fact ; and all the time I was in Africa I never saw a tree or other object which showed signs of having been struck by lightning. The only case of which I obtained any authentic report was that the coal magazine of the French Factory at Banana was burnt down in consequence of a lightning stroke in March, 1882. I have been recently informed, however, that just a year after the destruction of the French coal magazine, the large gin store of the Dutch Factory at Banana was similarly destroyed, a flash of lightning having kindled a great fire there, which lasted four days. As a result of these two accidents following so close on one another in the same locality, lightning conductors are now being set up at Banana, and the International Association of the Congo has had conductors fixed on all the magazines at Vivi. I find in DR. POGGE'S JOURNALS, which I am now preparing for publication, an instance, witnessed by that traveller himself, of a man being killed by lightning. As far as my own researches go I find scarcely any literature concerning the use of lightning rods, or the frequency of accidents from lightning in the tropics," etc.

The foregoing communication elicited a letter from J. J. MEYRICK (NATURE, Vol. 31, page 194), who wrote as follows:—

My experience confirms the remarks of DR VON DANCKELMANN in NATURE (page 127) respecting the little damage done by lightning in tropical countries. In the plains of India, at the commencement of the monsoon, storms occur, in which the lightning runs like snakes all over the sky at the rate of three or four flashes in a second, and thunder roars without a break for frequently one or two hours at a time. During twelve years' residence in India I heard of only two human beings, and I think, three buildings, being struck, although in parts of Lower Bengal the population amounts to more than 600 to the square mile. I always attributed the scarcity of accidents to the great depth of the stratum of heated air next the ground keeping the clouds at such a height that most of the flashes pass from cloud to cloud and very few reach the earth. This idea is supported by the fact that in the Himalayas, at 6,000 feet or more above the sea, buildings and trees are frequently struck. I have seen more than a dozen pine trees which had been injured by the lightning on the top of one mountain between 8,000 and 9,000 feet high. In the British Islands thunderstorms are said to be more dangerous in winter than in summer, and such a fact if true can be explained by the very thin stratum of air then intervening between the clouds and earth.

On the other hand, DR. A. ERNST wrote from Venezuela, where he had resided for twenty-two years:—

Thunderstorms are very frequent during the rainy season. They break out generally in the afternoon, about the time of the daily maximum of heat, whilst they are extremely rare in the morning, (I only witnessed one case) and during the night. Statistics of accidents do not exist, nor are there many lightning rods in use (in Caracas about half a dozen). But there are certain regions where the former are far from being uncommon, as, for instance, the country round the Lake of Valencia and the plains or *llanos* to the north of the Orinoco. In these a considerable number of cattle are killed by lightning every year, and I know also of several cases where houses were destroyed and people killed. The herds of cattle crowd together as soon as a thunderstorm begins, and the animals remain during the whole time with their heads down to the ground, thus avoiding instinctively that their pointed horns should act as lightning conductors (*sic*). In the neighbourhood of Maracay, at the Eastern end of the Lake of Valencia, accidents occur almost every year.....Near Caracas accidents are comparatively rare. During all the years of my residence here no more than six have come to my knowledge; in three of them some damage was done to buildings, in two cases large trees were split, and in one (October, 1882), a ploughman was killed while at work in the field, together with his two oxen, his driving stick (about four yards long and shod with an iron point) having acted as a lightning conductor.

To the above may be added the following extract from a recent number of the same Journal (NATURE, Vol. 94, page 261) :—

IN SYMONS'S METEROLOGICAL MAGAZINE for July last (1914), MR. L. C. W. BONACINA asked readers who had been in India whether lightning casualties, notwithstanding the severity of tropical storms, are not much rarer there than with us. He pointed out that many persons agree that thunderstorms in England are much more dangerous than in India. In the issue for October, a correspondent (G.G.) states that, in the course of his travels in various parts of India during a period of several years he had only known, or heard of one case of death by lightning, though a few high buildings, notably near Delhi, and tall trees in mountain districts had been struck. He, therefore,

answers Mr. Bonacina's question in the affirmative, the reason being given that thunderstorms occur higher up in the air. He states that he has never seen lightning in India so near the earth as in England.

It will be seen that the information elicited in 1914, is practically the same as that of thirty years earlier, and is based on general opinions, not on detailed and continuous observation. It would appear, therefore, that there is still need of careful records of the effects of lightning in the tropics.

The records of the Registrar-General of Ceylon give the average number of deaths by lightning in this country as ten per annum from 1891 to 1898, and eleven per annum from 1898 to 1910. The actual numbers for each year from 1899 are given in the following table:—

1899	...	...	16	1906	...	...	7
1900	...	...	18	1907	...	...	15
1901	...	...	17	1908	...	...	15
1902	...	...	13	1909	...	...	11
1903	...	...	2	1910	...	...	10
1904	...	...	9	1911	...	...	2
1905	...	...	4				

The population of Ceylon in the year 1911 was 4,106,350.—Annals of the R. B. G. Peradeniya.

TREATMENT OF SEEDS FOR PLANTING.

The following practical suggestions have been issued by the Jamaica Agricultural Society in regard to the treatment of seeds for planting :—All corn (maize), and especially Guinea corn (Sorghum) seeds should be treated before planting to prevent them being eaten by mice, rats, ants and birds. When Guinea corn is planted without any safeguard it is usually the case that ants attack it within a few hours of planting, eat out the germ, and few of the grains grow : then the seed is blamed.

There are two simple ways of treating these grains. For Guinea corn we prefer to take a pudding pan half full of wood-ashes ; take enough kerosene to damp this, but not to make a thin paste. Soak the seeds for two hours or three hours in water, then put them in the mixture and shake it through. The seeds get coated and can then be planted ; some then shake through a sieve to get rid of the superfluous wood-ashes, but this is not necessary.

The corn (maize) can also be treated in this way or by being coated with tar. Take coal tar, thin it with kerosene if necessary, put the corn in a sieve or pudding pan with holes punched in it, then pour the tar on and let it run through ; or the corn can be put in a bucket or kerosene tin, the tar poured on, the tin shaken until all the corn is treated, and the superfluous tar can be poured off. The tar method is a messy one but very effective.

We have found it sufficient to soak the grain in tar water which is made by keeping water for some weeks on tar, and stirring occasionally, then draw off enough of the water to soak the seed for three or four hours in it.

Altogether the kerosene and wood-ashes method is the cleanest and easiest.—The Agricultural News.

LEAF MOULD.

Next to farmyard manure, leaf mould is the chief agent by means of which the gardener ameliorates the soil. Whenever he has reason to know that specially congenial conditions must be established for the roots of his plants, the gardener "incorporates" leaf mould with his compost. If possible he selects the decayed remains of oak or beech, but if these are unobtainable he takes what he can get in the way of decayed leaves. The wise gardener does not, however, merely wait upon Nature to set up decay. He collects the leaves as they fall, and, pressing them down into close heaps, prepares his own stock of leaf mould.

It is evident that the changes which the leaves undergo in becoming mould are many and various. The heap develops a considerable temperature—the sure sign of bacterial and fungus activity. The closer the leaves are packed, the higher the temperature rises—and of this use is made in the employment of leaves with or without manure for the purpose of giving bottom heat to crops.

Of the orderly series of changes which set up leaf decay and lead to its consummation in mould, little is known. Nevertheless, the broad features are clear. For decay to be complete, and to result in a sweet humus grateful to plant, a certain amount of moisture is necessary. Otherewise decay is arrested, and a sour, peat like mass repugnant to most plants is produced. Lime is also necessary, whether it be supplied by the soil water, as is the case on soils containing limestone or chalk, or whether it be supplied by the leaves themselves. It may, perhaps, come as a surprise to gardeners to learn that leaves contain a considerable amount of lime, but so it is. Analyses made in 1913 by Mr. Colville* show that the following amounts of lime (in per cent. of calcium oxide) are contained in leaves :—

Red Oak, 1·73; Elm *(Ulmus americana)*, 2·39; Ben wood *(Tilia americana)*, 4·5; and Orange *(Citrus aurantium)*, 6·77.

Thus in their content of lime the leaves bear, as it were, the seeds of their decay. One part, and perhaps the most important, which is played by lime in fostering decay, consists in the neutralisation of the acids contained in leaves. For, as is well known, and as is pointed out by Mr. Colville, fresh leaves contain considerable quantities of acids—enough to give to incompletely decayed leaves a distinctly acid reaction. Hence, unless the decay has proceeded far enough, leaf mould used in large quantities may produce an initial ill effect on plants. It is doubtful, however, whether in ordinary garden practice any such risk is run, for in such practice the partially decayed leaves are mixed with soil and other ingredients, and any acidity they may have is quickly neutralised. Nevertheless, the gardener is wise who adheres to his general rule of choosing for his composts the nice well decayed debris, feeling kindly to his skilled fingers. Mr. Colville has been at pains to trace the gradual decline in acidity in decaying leaves, and finds that under proper conditions the acidity is lost, and the mould becomes alkaline in reaction in the course of a year. Where, of course, rainfall and lime are deficient, the acidity remains, and then, as anyone may see in woodlands, only certain kinds of plants can thrive. Gardeners are apt to be too much on their guard against using leaf mould in such situations. They need have no fear. Let them but collect this partially rotted mould, dust it with lime, and expose it to the weather, and in the course of a few months they will have an admirable material for garden use.

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* Annual Report, Smithsonian Institute, 1913.

MR. COLVILLE makes a good point, and one which we do not remember having seen made before, namely, that in soils poor in lime trees and plants generally act as surface concentrators of lime. Their roots absorb lime, and from the deeper layers of the earth send it to the trunk, and particularly to the leaves, so that when the latter decay, the lime forms a top-dressing, and is at the disposal of surface-rooting plants. Virgin soil from old forest land owes some, and perhaps much, of its fertility to the presence of lime. And this not only because of the virtue of lime itself, but also because nitrification is encouraged by the presence of lime.

Beside the prime agents of decay—bacteria and fungi—animals play a part in breaking down vegetable remains. Earthworms, as DARWIN showed long ago, are important agents of decay, mixing as they do, soil and vegetable particles and voiding them on the surface. MR. COLVILLE claims a similar role for myriopods, and estimates that in some regions these agents may manufacture leaf mould at the annual rate of more than two tons per acre.—

GARDENERS' CHRONICLE.

ROYAL BOTANIC GARDENS, PERADENIYA.

The following are the principal species introduced or reintroduced into the Royal Botanic Gardens, Peradeniya, during the period under review:—

Acacia molissima	...	(Forest Department, South Africa)
Agave tequilana	...	(Royal Botanic Gardens, Kew)
Balanites Maughamii	...	do
Bambusa polymorpha	...	(Forest Department, Burma)
Bolusanthes speciosus	...	(E. Budd, East Transvaal)
Brass-Laelia Helen	...	(Sander & Sons, England)
Caesalpinia horrida	...	(Hakgala)
Calosanthes indicus	...	(Horticultural Gardens, Lucknow)
Cassia beariana	...	(Ceylon Agricultural Society)
Cattleya Ashtoni	...	(Sander & Sons, England)
C. Portia	...	do
C. Heloisiae	...	do
C. labiata, X. C. alexandra	...	do
Calanthe veitchi	...	do
C. "Wm. Murray"	...	do
C. "Bryan"	...	do
Cardamom, Java variety	...	(A. J. van der Poorten, Galagedara)
Chamaedorea, sp.	...	(J. C. Harvey, Mexico)
Clitandra arnoldiana	...	(A. J. van der Poorten, Galagedara)
Copernicia cerifera	...	—
Cotoneaster frigida	...	(Royal Botanic Gardens, Calcutta)
Cynoglossum furcatum	...	do
Cytisus proliferus	...	(Royal Botanic Gardens, Kew)
Dalbergia sissoo	...	(Horticultural Gardens, Lucknow)
Desmodium podocarpum	...	(Royal Botanic Gardens, Calcutta)
Echium candicans	...	(Royal Botanic Gardens, Kew)
E. simplex	...	do
Eucalyptus citriodora	...	(Horticultural Gardens, Lucknow)
Ficus Krishnae	...	(Royal Botanic Gardens, Calcutta)
Guaicum officinale	..	(Department of Agriculture, Trinidad
Hibiscus (collection)	...	(Botanic Gardens, Bangalore)
Hippophae salicifolia	...	(Royal Botanic Gardens, Calcutta)
Jacquinia sp.	...	(J. C. Harvey, Mexico)

Jak, Johore variety	..	(F. L. Daniel, Colombo)
Kennedya comptoniana	...	(M. Herb, Naples)
Landolphia klainii	...	(A. J. van der Poorten, Galagedara)
L. owariensis	...	do
Laelia cinnabarosa	...	(Sander & Sons, England)
L.c., X. L. purpurata	...	do
L. pacavia	...	do
L. purpurata, X. L. cattleya "C. S. Ball"	...	do
L. Cattleya Nyasa	...	do
L. C. fascinator	...	do
L. C. Kathleen	...	do
L. C. martinetti	...	do
L. C. schutzeriana	...	do
L. C. canhamiana	...	do
L. C. elegans	...	do
L. C. statteriana	...	do
Leea robusta	...	(Royal Botanic Gardens, Calcutta)
Mango "Pico"	...	(Division of Horticulture, Manila)
Prosopis juliflora, "Mesquit Bean"	...	(Ceylon Agricultural Society)
Metroxylon longispinum	...	(Botanic Gardens, Buitenzorg)
Musa textilis	...	(Department of Agriculture, Manila)
Peristrophe speciosa	...	(Royal Botanic Gardens, Calcutta)
Statice arborescens	...	(Royal Botanic Gardens, Kew)
Stereospermum sinicum	...	(Hakgala)
Vanda teres, var. Andersonii	...	(J. H. de Saram, Kandy)
V. Miss Ganejuina	...	do
Voandzeia subterranea	...	(Botanic Gardens, Mauritius)
Vitis repens	...	(Royal Botanic Gardens, Calcutta)

—Ann: Rept. of the Supdt. of Bot: Gardens, Ceylon, 1914.

ROTATION OF CROPS IN JAFFNA.

C. M. SINNYAH MUDALIYAR.

(A paper read at the meeting of the Jaffna Tobacco Committee held 24th August 1915).

Rotation of crops means raising of various crops, one after the other, on the same soil. If crops of the same kind are grown continuously on the same soil, the efforts of the farmer will not be crowned with success, for reasons stated below.—

(*a*). It is a well-known fact that every kind of crop raised on a soil removes from that soil that special kind of plant food required for that crop; consequently, by raising the same kind of crop year after year on a soil, that soil becomes denuded of that special kind of plant food and the result will be a deterioration of the crops raised on that soil.

(*b*). Growing repeatedly the same kind of crop on a land conduces to an abnormal increase of insects and fungoid pests which damage that crop, there being a continuous supply of food for those pests. To make these plant pests either to die from want of their food or to make them go away elsewhere in search of food, it becomes necessary that different kinds of crops should be raised, one after the other, on the land. This is the very reason why coffee failed in the Central Province and it will be no wonder if tea too fails in course of time.

(*c*). The plants secrete their poisonous substances in the system through their roots, into the soil just as animals secrete theirs. If steps are not taken to nullify the bad effects of these poisonous excretions, they, in course of time, will become deleterious to the plants growing on that soil. In view of these reasons, it is absurd to attempt to grow coconuts, palmyrahs or other plants once again on the same soil on which they grew once before. I have observed that several farmers who are ignorant of the above fact have been sadly disappointed in their attempts to grow coconuts once again on the lands on which those plants grew once before. The poisonous excreta of the plants can be divested of their poisonous character by a liberal supply of lime, leaf manure, etc., and by deep and frequent tillage.

(2). Rotation of crops is very advantageous to the farmer for reasons stated below :—

(*a*). He can control the devastations caused by insects and fungoid pests.

(*b*). He can, weather permitting, be profited by growing some useful crops on paddy lands which now lie fallow from February to August.

(*c*). He can increase the supply of plant food in a soil by cultivating thereon leguminous crops which, as a rule, store up nitrogenous food from the air. This food would be available for the succeeding crop.

(*d*). He can get a good supply of food for his cattle which are indispensably necessary to every farmer for manuring and tilling his soil.

(3). Rotation of crops is practised to some extent, in some parts of the Jaffna District, but it is not carried out in the proper way. In paddy lands where irrigation is possible by means of ponds and wells, tobacco, chillies, gingelly or kurakkan is grown immediately after the paddy crops have been harvested. In garden lands, tobacco, millet, and kurakkan are grown, one after the other. I have to point out, in this connection, that raising two cereal crops such as millet and kurakkan, one after the other, on the same soil, is not a very judicious course. I would advise the farmers to give up growing kurakkan after millet and to grow in lieu thereof sunn hemp or some other leguminous plant and to bury them into the soil when they are about to flower. This course, I need not point out, would obviate the necessity for expending a large sum of money in procuring green leaf manure from outside as it is at present done. The farmer thinks that any kind of leaves will do for manuring tobacco. He does not know that the leaves of the leguminous plants alone are the leaves that are well suited for manuring tobacco whose leaves are used for smoking.

(4). The special points to be observed in rotation of crops are the following :—

(*a*). Plants are either shallow-rooted or deep-rooted. The former kind of plants make use of the plant food contained only in the upper layer of the soil while the latter kind make use of the plant food contained both in the upper and in the lower layers. The object of the farmer being to derive as much profit as possible from the soil with the least possible outlay, it becomes necessary that both kinds of plants should be grown one after the other.

(*b*). Some plants require plant food containing a large quantity of potash while others require food containing a large quantity of either nitrogen or phosphorus. The soil contains these plant foods not in a fixed proportion. In order to derive as much profit as possible from one's land, it becomes necessary that the owner thereof should raise such crops as are suitable to his soil, one after the other.

(*c*). Nitrogenous plant food is too scanty in the Jaffna soil. Any plant will not thrive well, if a good supply of this kind of food is not available in the soil. To increase the supply of this plant food in the soil, it becomes necessary that leguminous crops, such as sunn hemp, dhaincha, pease, crotolaria or kavilai (tephrosia) should be grown on all soils and buried therein every year.

5. The proper course of rotation of crops suitable to Jaffna is to raise the following crops one after the other to suit the seasons.

FOR PADDY LANDS.

1. Paddy crop. | 2. Leguminous crop.

FOR GARDEN LANDS.

1. Tobacco crop. | 2. Cereal crop of millet, etc.
3. Leguminous crop.

EXPERIMENTS WITH VARIOUS TYPES OF LUCERNE.

E. BREAKWELL.

The lucernes grown in the Experiment Farms of New South Wales may be divided into the following types: Tamworth, Peruvian, Arabian, Sand, Turkestan and American.

The Tamworth type is characterised by an erect growth, rather woody stem, large tap root and leafy branches. The Hunter River and Mudgee types are essentially similar to the Tamworth. The Mudgee type, however, at Cowra seems to thrive better during the winter months than the Tamworth or Hunter River, probably due to local acclimatisation.

Owing to its erect habit, the Tamworth type is particularly adapted to haymaking, and up to the present has produced the largest quantity of food of all lucernes at Grafton, Wollongbar, Yanco and Bathurst Experiment Farms, and at Hawkesbury Agricultural College

Peruvian lucerne can very readily be distinguished from the Tamworth by the hairiness of the leaves; it has fewer stems and these are less branched. It is credited with thriving best in a climate of mild winters and hot dry summers; but on the whole in those New South Wales Experiment Farms under such a climate, Peruvian lucerne did not prove superior to the Tamworth.

Arabian lucerne required somewhat the same climatic conditions as Peruvian, but was much more sensitive to cold. This lucerne is characterized by extremely succulent stems containing less fibrous matter than Tamworth. It is as hairy as Peruvian and has much larger leaves than the latter. Another character is the short life of the tap root, which soon rots while the new growth springs from shoots from the surface of the tap root. It is probable that this characteristic will militate against its drought resistance. It does well at Wollongbar, Cowra and Bathurst Experiment Farms At Wollongbar during the cooler months it is superior to Tamworth. It makes rapid growth after cutting.

Sand lucerne, as originally bred in America is said to be a cross between *Medicago falcata* and *M. sativa*. In New South Wales it has been tried to Wollongbar, Grafton, Glen Innes, Cowra, Bathurst and Wagga, Hawkesbury and Nyngan. Owing to its prostrate or semi-prostrate habit Sand lucerne cannot be recommended for hay. But it seems to be particularly adapted at pasture, owing to its heavy growth of foliage at the crown,

There appears no doubt that Sand lucerne is more drought resistant than any other lucerne. At Nyngan it subsisted during the year 1914 with only 6 or 7 inches of rain. The best results have been obtained by sowing thinly in dry districts in rows 2 ft. 6 in. or 3 ft. apart.

Turkestan lucerne is characterised by thick leafy growth and rather small leaves. In no case, however, has it proved superior to Tamworth.

American lucernes in appearance are similar to the Tamworth type. They show, however, the results of acclimatisation in America, and certain local strains have there been raised which have proved superior to the older types. Such are Montana, Oasis, Northern Californian, Kansas and Grimm lucernes.

All these are being tried at the Experiment Farms. The results of acclimatisation in America are well shown by the progress of certain types here. For example, Montana lucerne coming from a district with very cold winters and extremely hot summers does very well at Glen Innes which has a similar climate, and has proved superior to Tamworth. Although not growing much higher than Tamworth it stools more considerably and produces a greater bulk of food. Its tap root is much larger and the other roots are more numerous than those of the Tamworth type.

Northern Californian, coming from a district with a similar climate, has also done well at Glen Innes.

Kansas lucerne is showing promise at Hawkesbury and at Cowra.

Oasis lucerne, credited with standing dry conditions in America is doing well at Grafton, Cowra, Bathurst and Yanco. It is semi-prostrate and appears similar in structure to Sand lucerne.

Other types of lucerne are being tried at the Experiment Farms. Algerian does best at Glen Innes. Chubut lucerne, from Patagonia, is thriving well at Yanco.—MONTHLY BULLETIN.

RAINFALL FOR JULY, 1915.

Place	1915	1914	Place	1915	1914.
	in.	in.		in.	in.
Colombo	12·63	3·65	Kurunegala	9·53	·55
Kandy	12·90	5·96	Batticaloa	3·14	1·15
Galle	15·18	6·07	Badulla	4·79	0·33
Jaffna	1·21	0	Ratnapura	36·21	9·77
Anuradhapura	1·06	0	Nuwara Eliya	20·06	12·39

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